

Sourthern Rhodesia

Report of Commision

to enquire into the Preservation, etc., of the Natural Resources of the Colony.

April, 1939

INDEX

- I. Introduction page 2
- II. Natural Resources and their Importance page 3
- III. Geographical. Physical and Geological Features page 5
- IV. Allocation of Land to Natives and Europeans page 7
- V. The Soil. General Observations on Soil Erosion page 10
- VI. Soil Erosion on Land under Native Use page 11
- VII. Measures already taken to combat Soil Erosion on Land under Native Use page 14
- VIII. Soil Erosion on Land under European Use page 15
- IX. Measures already taken to combat Soil Erosion on Land under European Use page 17
- X. General Recommendations as to the Prevention and Control of Soil Erosion page 19
- XI. Water Resources page 25
- XII. Forests page 31
- XIII. Afforestation page 39
- XIV. Overstocking page 41
- XV. Veld Management page 44
- XVI. Breeds of Cattle page 49
- XVII. Minerals page 51
- XVIII. National Parks, Game Reserves and Open Spaces page 54
- XIX. Miscellaneous page 57
- XX. National Resources Board page 63

ILLUSTRATIONS

- Plate No. 1. Erosion and Denudation caused by Stock.
- 2. Erosion caused by disused Roads.
- 3. Sheet Erosion on newly cultivated sandy soil. Erosion on first year Tobacco Land. Erosion on fallowed Tobacco Land.
- 4. Gully Erosion.
- 5. Incipient Gully Erosion in Maize Land where the slope does not exceed 1 in 30.
- 6. Discharge from a Contour Ridge causing damage to a Farm Road. Erosion arising from Road Drains. Erosion as seen in the Inyanga District (origin uncertain).
- 7. Land recovering from Erosion through Contour Ridging. A Crop reaped from Protected Land.
- 8. Wooded and denuded Hillsides at Hunyani Poort.

APPENDICES

- I. Rural Development work for Natives. Early History and Growth. (By the Agriculturist, Native Affairs Department) page 65
- II. Means of Improving Soil and Water Conservation. (By the Division of Irrigation) page 66
- III. Expenditure on Soil Conservation for European Areas page 68

IV. Memorandum on Conservation of Natural Resources. (By the Director of Irrigation)
page 69

V A Conservation Policy for Matabeleland. (By the Irrigation Engineer for Matabeleland)
page 71

VI. Memorandum describing Methods for Securing Best Grazing Use of a Typical
Granite Farm. (By the Agriculturist, the Chief Animal Husbandry Officer and the Chief
Chemist, Department of Agriculture, Salisbury) page 73

COMMISSION

BY His Excellency Sir Herbert James Stanley, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander in Chief in and over the Colony of Southern Rhodesia.

TO Mr. Justice Mcllwaine, MA., LL.B., K.C., Samuel Milligan, Esquire, C.B.E., Arthur Cyril Jennings, Esquire, A.M.I.C.E., and George Arthur Davenport, Esquire.

GREETINGS:

Whereas it is deemed expedient to appoint a Commission to enquire into and report upon the extent to which the natural resources of the Colony are deteriorating or being wasted through various causes:

Now know ye that I, the Governor aforesaid, reposing great confidence in your knowledge, discretion and ability, have authorised and appointed, and by these presents authorise and appoint you, the said Mr. Justice Mcllwaine, M.A., LL.B., K.C. (Chairman), Samuel Milligan, Esquire, C.B.E., Arthur Cyril Jennings, Esquire, A.M.I.C.E., and George Arthur Davenport, Esquire, to be Commissioners for the purposes aforesaid; and for the better effecting of the purposes of this my Commission, I do invite all such persons as you or any three of you shall judge necessary, by whom you may be better informed of the subjects herein submitted for your consideration, and every matter connected therewith, to place before you the fullest information on the subject of the enquiry, to grant you access to all such official books, documents, papers and records as may assist you in the enquiry, and to require of and concerning the premises by all other lawful ways and means whatsoever.

The terms of your reference shall include the following matters:-

To enquire into and report upon the extent to which the natural resources of the Colony are deteriorating or being wasted through -

(a) soil erosion; (b) destruction of trees, grasses and other vegetation, whether taking place in the course of farming and mining operations or otherwise; (c) overstocking and improper or undesirable methods of farming and treatment of the land; (d) interference with the natural courses, catchment areas, swamps or other sources of streams or rivers; (e) any other causes.

(2) To make recommendations regarding the methods deemed most effective and expedient for preventing, controlling and checking such deterioration and waste and restoring, conserving and increasing such natural resources.

(3) Such other matters appertaining to the aforesaid terms of reference as may be considered useful and expedient.

And I further will and direct, and by these presents ordain, that you, or any three of you, do report to me, with all convenient speed, your opinion on the matters herein submitted for your consideration:

And I further will and command, and by these presents ordain, that this my Commission shall continue in full force and virtue until you, or any three of you, shall have finally reported upon the several matters aforesaid, or otherwise until this my Commission shall be by me revoked; and that you, or any three of you, may from time to time proceed in execution thereof, although the same be not continued from time to time by adjournment; and that you, or any three of you, shall have liberty to report to me your several proceedings from time to time as the same or any part thereof may respectively be completed and perfected.

In witness whereof I, the Governor aforesaid, have caused this my Commission to be issued on this twentieth day of September, in the year of our Lord one thousand nine hundred and thirty-eight.

H. J. STANLEY, Governor.

Governor's Office, Salisbury, Southern Rhodesia.

To His Excellency Sir Herbert James Stanley, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Governor and Commander in Chief in and over the Colony of Southern Rhodesia.

MAY IT PLEASE YOUR EXCELLENCY:

In terms of Your Excellency's Commission dated the 20th September. 1938, and published in the Government Gazette of the 23rd of that month, we, your Commissioners, were appointed to investigate and report upon the seven! matters set out therein.

Having completed our investigations in accordance with the aforesaid terms of reference, we have the honour respectfully to submit to your Excellency the following report:-

I. INTRODUCTION.

1. In view of the wide range of subjects covered by the terms of reference and seeing that the problems connected therewith are sometimes local in their incidence or liable to vary from place to place, it was realised that it would be necessary to travel widely in order to get a satisfactory grasp of local conditions and to give persons familiar therewith an opportunity of expressing their views thereon, as in many cases their evidence otherwise might not have been forthcoming.

2. The normal time for the commencement of the rainy season being near at the time of the appointment of the Commission, it was decided to visit first the districts where, ordinarily, rains make travelling difficult and thereafter places which are generally

accessible in all weathers. Notwithstanding the abnormally wet season, your Commission was able to adhere, in the main, to the itinerary which had been fixed, although prevented from making certain short visits which had been contemplated. In all some 5,300 miles were travelled within the Colony.

3. The Commission was pleased to find great interest taken in the matters referred to it for consideration not only by persons directly affected but also by members of the public, who displayed a gratifying concern for the preservation of the natural resources of the country and their attendant amenities. The total number of witnesses was over 200. Altogether 1,523 foolscap pages of typescript evidence was recorded. In addition, memoranda were submitted by people unable to attend in person and by others at the request of the Commission.

4. Your Commissioners desire to record their appreciation of the help and consideration readily extended to them by the public generally and of the assistance freely given by the officers of the various Government Departments both at headquarters and in the districts. While it would be invidious to single anyone out for special mention, great satisfaction was experienced at the keenness shown by engineers and other technical and general officers chiefly concerned with the questions coming before the Commission.

5. In pursuance of arrangements made by this Government with the Government of the Union of South Africa and the Resident Commissioner of Basutoland, respectively, two of your Commissioners the Chairman and Mr. S. Milligan visited the Union and Basutoland. The officials of the various Departments at Pretoria were most helpful in discussing and giving information on problems, common to both countries, being considered by the Commission. Of special interest were inspections near Pretoria and Warmbaths of pasture research stations in company with Dr. Pole Evans, Chief, Division of Plant Industry, and officers of that Division. The visit to Basutoland was most instructive on the subject of soil erosion, which, having reached enormous proportions there, is being successfully combated by heroic measures. His Honour, the Resident Commissioner, the Director of Agriculture, and other officers gave the visiting Commissioners every facility for acquainting themselves with what is being done in antierosion works, pasture improvement and other matters relevant to their enquiries.

6. Your Commissioners consider it desirable, in order to get a clearer comprehension of the matters arising in their report, that they should begin by stating what they understand by "natural resources" and then, in order to secure an understanding of the importance of guarding these resources call attention to the unfortunate results which have followed their neglect elsewhere.

7. Thereafter a condensed description of the general geographical, physical and geological features of the Colony will be given, and, in view of the relationship between the inhabitants of the country and its resources, it will be shown how the land has been allocated for the use of natives and Europeans respectively.

8. Having, as briefly as possible, set out so much as is deemed necessary for an introduction to and a better understanding of the Report, your Commissioners will deal with the specific questions which have been referred to them. In so doing, it may be found necessary to depart to some extent from the precise order and wording of the terms of reference, but it is trusted that there will be no omission to deal with all the matters referred to them.

II. NATURAL RESOURCES AND THEIR IMPORTANCE.

9. The subject of the Commission's investigation being the natural resources of the Colony, it is important to determine in what these actually consist. It appears to be a fairly common view that the term "natural resources" connotes only such things as constitute the material wealth of a country. The Commission is of opinion that the term should, for the purposes of their investigations at least, be used in a wider sense and include not only those things which provide for man's material wants, but also all those gifts of nature which minister to the aesthetic and finer side of his being. For example, it is submitted that the value of a tree-clad hillside should, apart from the land, be estimated not merely in terms of the marketable timber or firewood that it contains, or even of the beneficent effect it may have on moisture and temperature conditions; regard must also be had to the pleasure given by such things as the beauty of its varied shades and colour, the company of bird and animal life it harbours and its artistic setting in the landscape.

10. Relatively speaking, this Colony is in the early years of settlement by Europeans. Hitherto, the many wide acres of virgin ground may have led the general public, if they ever gave any thought to the matter at all, to regard the manner in which the user of the soil treated it as a matter of his own concern. In a richly wooded country, there is a tendency to regard trees as of little account and view their widespread destruction with comparative unconcern. This, and an apparently similar indifference as to water, pasturage and other resources of the country, happily, appears to be on the wane.

11. It will be seen from later passages of this report that, although destruction of the natural resources of the Colony has been considerable in some directions, it is not yet too late to take steps to arrest destruction and deterioration and in a certain measure retrieve what has been lost.

12. To assist in the realisation of the gravity of the subject and in the hope it may lead to a determination to safeguard the natural wealth of the country, attention is directed to the dire consequences which have followed in other lands when man's operations were allowed to upset the balance of nature by abusing her resources. History and modern research show that to this cause may be largely traced the decline and fall of mighty empires of the past, such as Persia, Babylon, Assyria and Chaldea. Rich fields and once populous cities lie buried under many feet of sand. The hanging gardens of Babylon only possess an interest for the antiquarian and the ruins of the palace of Darius, the King of Kings, lie in an uninhabitable wilderness.

13. It may be that visions of such decadence possessed the poet when he wrote :

"They say the Lion and the Lizard keep The Courts where Jamsheer gloried and drank deep."

Buried cities and other architectural remains found in Arabia, Northern Africa, and even in the Sahara desert, bear silent testimony to the results of the upsetting of the balance of nature by man in destroying the forests and vegetation which once covered the land. Ruins of vast irrigation works in Mesopotamia, on a scale which has not been surpassed in modern times, indicate that their disruption was due to failure to control and preserve the watersheds in the upper reaches of the Euphrates and Tigris Rivers.

14. The coastal regions of the Mediterranean Sea were once well clothed with trees and other vegetal cover. These have gone and have been followed by the unimpeded wash of much of the fertile soil into the sea.

15. Examples of the deterioration of the land in recent times through the action of man may be found in many parts of the world. It appears from the report of the Drought Investigation Commission in 1923 that, in the Union of South Africa, soil erosion and deterioration or disappearance of the flora is widespread and that through these and other causes large areas of once fertile country are being overtaken by semidesert conditions.

16. In a report recently issued by the Union Department of Agriculture on pasture research, Mr. Rowland, Pasture Research Officer, writes:

We see whole districts which were recently ploughed for grain and which are today lying abandoned and are carrying ruderal and wellnigh useless vegetation. Throughout the Union the carrying capacity of the veld is declining at an everincreasing rate. Countless springs and streams which were perennial are today drying out. The desert is marching eastwards. Karoo bush the worst of it unhappily is intruding throughout the short grass country. Lastly, erosion, more spectacular and possibly the more advanced stage of the other processes, is clutching at the rich soils of the merino country The veld can no longer be regarded as a stable source of supply. It is moving downhill, trampled and pushed by the hoofs of tens of thousands of starving animals, loosened and carried off by wind and water to the sea."

17. In Basutoland, the mountainous nature of the country and the agricultural and pastoral methods of the people resulted in almost unbelievable destruction of the arable land and deterioration of the pastures. A Commission, generally known as the Pim Commission, was appointed by the Secretary of State to enquire into and report upon the position of the country from the financial and economic point of view. The report, published in 1935, called special attention to the erosion position and recommended the taking of early steps to combat it. As a result, a grant of £160,233 was made from the Colonial Development Fund for antisoil erosion work. This was put in hand at once. Extremely good progress has been made and excellent results are already apparent, but the millions of tons of priceless soil which have been swept to the sea can never be replaced and no amount of money or labour can restore the country to its original state.

18. In no part of the world, either in ancient or modern times, has the destruction of the country's natural resources been so rapid as in the United States of America. In the earlier years of settlement, thousands of immigrants from Europe regarded the resources of the land as inexhaustible and proceeded on their westward march, laying low the forests and ploughing up the virgin land.

19. The destruction which took place in the ancient world and among primitive people with simple tools if sure was slow. The advent of the motor tractor and other modern implements increased man's power of destruction a hundredfold.

20. The high prices of agricultural products during the war and postwar period led to the bringing under cultivation of large areas in the Great Plains of the Middle West, where the vegetal cover should never have been broken. Ensuing droughts and wind and rain on the unprotected surface produced desert conditions and pauperised the population. A spectacular dust storm arising in this area in May, 1934, obscured the sun over a wide area of the N.E. States. invaded the Capitol at Washington and travelled beyond the Atlantic seaboard. This, and disastrous floods caused by the unimpeded flow of the rainwater over denuded lands, helped to focus attention on the gravity of the situation. The preservation of the natural resources has now become one of the leading national questions in the country and vast sums of money have been voted and extensive organisations created for coping with the matter, notably, the Soil Conservation Service established under an Act of Congress of 1935.

21. The recent findings of a Committee appointed by the Government of South Australia to report on the question of soil erosion discloses how manmade desert conditions have arisen there.

22. *Salus populi est suprema lex.* (The welfare of the people is the supreme law.) The conservation of the natural resources of the country is the concern of every member of the community. Those who during their short lifetime are entrusted with the handling of the land or other asset of the country should not be denied the right to use it reasonably. but they should be regarded as trustees neither entitled to mistreat, squander nor destroy it regardless of the consequences to future generations.

III. GEOGRAPHICAL, PHYSICAL AND GEOLOGICAL FEATURES.

23. The following brief account of the geographical, physical and geological features of the Colony has been taken from a handbook issued by the Government for the use of prospective settlers:

24 Southern Rhodesia forms a plateau drained on the north by the Zambesi River, and on the south by the Limpopo River, and contains approximately 152,000 square miles, an area nearly twice the size of Great Britain. It extends from the Zambesi River in latitude 15° 36' S. to the Limpopo River in latitude 22° 25' S., and from the Bechuanaland Protectorate in longitude 25° 14' E. to Portuguese East Africa in longitude 33° 4' E. Only a narrow strip in the Zambesi Valley and a larger tract in the basin of the Limpopo and

Sabi Rivers are under 2,000 feet above sea level, the actual lowest point where the Limpopo River leaves the Colony being 660 feet above the sea. It is thus a highlying country, and it has been estimated that 24 per cent, lies over 4,000 feet above sea level. This high ground is not a mountain range, but a plateau of subdued relief (the " high veld ") which stretches in a belt from westsouthwest to eastnortheast with an important offshoot to the north in Lomagundi and western Mazoe, and again on the eastern border offshoots trend both to the north (Inyanga) and to the south (Melsetter).

25. The main plateau is due to the gentle uplift of a plain, the axis of the uplift forming the watershed from which the rivers flow northwestward to the Zambesi and southeastward to the Limpopo and Sabi Rivers. East of the offshoot of high ground in Lomagundi the rivers flow in a northeasterly direction.

26. All the rivers in their middle courses have eroded deeply into the plateau, and thus carved out ranges of hills and clusters of kopjes, the summits of which may still rise to the height of the warped surface of the uplifted plateau. By the continuance of this process gently shelving plains diversified by steep-sided hillranges and isolated kopjes are being formed. The headwaters of the rivers are cutting back towards the axis on the plateau, and in many places have formed a scarp three to five hundred feet in height by which descent is made from the high veld " plateau to the lowerlying country of diversified relief, which may be called the middle veld." The scarp is particularly noticeable around the basin of the Mazoe River, the Shamva railway descending the scarp between Selby Siding (4,700 feet) and Mazoe Siding (4,233 feet). The traveller by the main railway line between Plumtree and Umtali travels along the high veld, and obtains glimpses of the middle veld to the south of the line around Heany Junction, to the north of the line beyond Ruwa, and finally descends into it beyond Headlands, where the change in the type of scenery is well recognised, though there is no change in the geological formation. In the narrow belt of high ground along the eastern border the greater rainfall combined with the steeper gradients has enabled the rivers to erode deeply and produce a mountain chain with many summits. Inyangeni Mountain (8,250 feet), situated 48 miles north of Umtali, is the highest point in Southern Rhodesia.

27. It thus happens that except along the eastern border the highest hills, measured from their base on the plains to summit, are found at some distance away from the elevated tract which forms the high veld.

28. The "low veld" in the basins of the Zambesi, Limpopo and Sabi Rivers is distinguishable from the middle veld mainly by a change in the geological formation from the granite and metamorphic rocks with their characteristic ranges and isolated kopjes to the sedimentary or volcanic formations with their low tabular hills. In the Zambesi basin, and particularly in the Darwin and Lomagundi districts, the change is marked by a precipitous scarp, known as "The Escarpment," which may reach a height of 1,500 or 2,000 feet. It is probable that faulting has had some share in the formation of the scarp.

29. The approximate areas occupied by the different rock formations occurring in Southern Rhodesia are as follows :

(Percentage proportion of total area approximately 152,000 square miles).

Granite 49.5
Karoo sedimentary rocks 15.3
Kalahari formation 11.2
Basement schists 8.5
Lomagundi formation 5.7
Basalt and dolerite 5.1
Umkondo formation 2.7
The Great Dyke 0.8
Area not determined 1.2

30. As the soils of the country are derived for the most part from the underlying rock formations, the type of soil which predominates in any particular area is very largely governed by the local geological features. Overlying granite and the Kalahari formation, the latter of which is made up of sand, ironstone and chalcedony, the soils are chiefly of sandy character; although on the granite, loams and still heavier soils are often met with. The Kalahari sands are of very poor character, as a rule, and it is upon the granitic soils that the bulk of the bright Virginia tobacco is grown in Rhodesia.

31. The Karoo formation is subdivided into two series: (a) basaltic lavas, which are included with dolerite in the above table in regard to the area over which they occur, and (b) the sedimentary rocks, comprising grits, sandstones and shales, etc., which yield soils varying in character from light sands, through loams to heavy clays depending upon whether sandstones or shales predominate.

32. Overlying the basement schists, which are frequently grouped by farmers simply as "formation," and which include greenstone and undifferentiated schists, we find red and chocolate loamy soils, which are included among those soils most suitable for the production of maize. The Lomagundi and Umkondo formations are made up largely of quartzites, shales and slates, the firstmentioned rock, as a rule, weathering into a light sandy loam, whilst the shales and slates yield clays: soils of all physical types are therefore found on this formation, some of which are highly fertile.

33. Intrusions of dolerite ("whinstone"), which give rise to a red loamy soil, are met with more particularly in the granite areas, and on "sand veld" farms; where they occur the value of the holding for agriculture or mixed farming is greatly enhanced. The Great Dyke, which is a belt of country about four miles wide, extending from the Umvukwe Hills on the LomagundiMazoe border to the Doro Hills in Belingwe, is made up of norite, serpentine and enstatite rocks which yield red loamy soils characteristically rich in magnesia. These soils afford excellent grazing for cattle, and are suited more particularly for dairy farming and beef production.

34. On every geological formation black vlei soils are to be found which generally possess a greater reserve of fertility than the more normal soil of the • formation. With reference to these black soils, the Director of Geological Survey remarks as follows: " Whilst in many instances a black soil is a residual soil, in others there is considerable admixture of rainwash, and it almost seems possible for it to grade into an alluvium. However that may be, it is not possible to give any figures for the total area of black vlei soil in the country or even to indicate the relative percentages on different formations. It is probable that the largest areas of black vlei (or black plateau) soil occur on the Karroo formation."

35. The character of these vlei soils is dependent upon the formation on which they occur. Those occurring on the granite, which are naturally of lighter type than those found on the basement schists, dolerite and basalt, are too wet in many instances for summer cultivation, but hold sufficient moisture to carry a crop of wheat in the dry season, for which purpose they are largely used in some districts. Where the natural drainage is satisfactory and the rainfall is adequate, the heavier types of vlei soil on the basement schists, etc., are capable of giving large yields of maize, and it is upon this class of soil, especially that overlying the basement schists, that a considerable part of the maize crop is grown in Southern Rhodesia.

IV. ALLOCATION OF LAND TO NATIVES AND EUROPEANS.

36. Prior to European settlement in the country, the land was occupied by Natives according to their tribal customs. The land was vested in the Chief and allotments were made by him or on his behalf. Each member of a family was entitled to garden land and had certain rights to fallow land. Grazing was on a communal basis.

37. Article 14 of the Royal Charter granted to the British South Africa Company in 1889 made suitable provision for the safeguarding of the natives' 'and rights.

38. The first definite action to set aside Native areas was taken in 1894, when a Land Commission was appointed, and the Shangani and Gwaai Reserves were constituted.

39. Article 81 of the OrderinCouncil 1898 imposed on the Company the obligation of setting aside sufficient land for the occupation of natives and article 83 provided that a native "may acquire, hold, encumber and dispose of land on the same conditions as a person who is not a native."

40. In 1902, there was a general setting aside of land as Native Reserves. Alterations and amendments of these areas took place from time to time. In 1914, the High Commissioner appointed the Southern Rhodesia Native Reserves Commission to enquire into the whole question of Native Reserves and to make recommendations thereon.

41. The outcome of the report of this Commission was an OrderinCouncil of 1920 by which certain defined lands " known as Native Reserves, were vested in the High Commissioner and set apart for the sole and exclusive use and occupation of the Native

inhabitants of Southern Rhodesia." This OrderinCouncil did not, however, in any way affect the Natives' right to land elsewhere, as given by the OrderinCouncil 1898; a right which had been exercised in a few cases.

42. It may be stated here, without tracing the history of the Native Reserves subsequent to 1920, that these Reserves are now vested in a Board of Trustees constituted in terms of "The Southern Rhodesia Constitution (Amendment) Letters Patent of 1937."

43. The question of the expediency of allowing Natives to acquire land indiscriminately and of the friction which might arise with European neighbours was discussed in the Legislative Council and elsewhere, and in 1925 a Commission known as the Land Commission was appointed by the Governor to enquire into and report upon the question.

44. Following the report and recommendations of the Land Commission, the "Land Apportionment Act, 1930," was enacted. This Act provided for the classification of all land in the Colony (other than that then comprised in the Reserves or set aside for the sole and exclusive use and occupation of Natives) as the European Area, the Native Area, the Undetermined Area, the Forest Area and the Unassigned Area.

45. For the purposes of this Report, the last three areas are of minor interest. The chief result of the Act has been the constitution of the European Area, which consists of all land not included in the Native Reserves, as then constituted, and not situated in the other four areas, and the Native Area, being the land described in the first schedule to the Act, estimated to contain approximately seven and one half million acres.

46. The underlying principle of the Act is that, subject to certain minor temporary exceptions, land in the Native Area, commonly referred to as the Native Purchase Area, may be granted to or used by Natives only, on such conditions as may be prescribed, and that Natives should not hold or occupy land in the European Area.

47. Section 24 of the Act provided, with certain exceptions, that no agreements should be made permitting of the occupation by Natives of land in the European Area on payment of rent and that existing agreements should not endure beyond a period of six years after the date of the Act coming into operation. By an amending Act-31 of 1936 this period was extended until the 31st July, 1941. It will be seen later in this Report that considerable importance is attached to the situation already created by Natives occupying European owned land and the question of future policy in regard thereto.

48. It appears from a survey of Native Reserves that, having regard to the present limited water supplies, the methods of farming adopted by Natives, the number of their stock and the contemplated removal of those located in the European Area in terms of section 24 of the "Land Apportionment Act," as amended, sufficient accommodation may not be available for them in the Reserves and the Native Purchase Area.

49. In order to provide further land for the requirements of Natives, the Government has, in the past few years, acquired a considerable area of privately owned land in various

parts of the country. Land thus acquired is referred to as the New Native Area or Native Occupation Areas.

50. It should be noted that whereas the Native Reserves and the Native Purchase Area have been constituted by and are governed under specific statutory authority, no such position obtains in the case of the New Native Areas or Native Occupation Areas, which, in terms of the Land Apportionment Act, are still part of the European Area.

51. The total indigenous population of the Colony at the end of 1937 and 1938 was estimated at 1,144,909 and 1,185,002 respectively, distributed as follows:

	1937	1938
In Native Reserves	755,505	781,493
In Native Purchase Areas	59,190	65,305
On Crown Land in European Area	136,119	132,015
On alienated land	184,999	194,503
On Native Occupation Areas on Crown Land	5,674	7,638
On mines and in towns	3,422	4,048

52. It is interesting to note that there is no indication of the contemplated movement from the European owned land. On the contrary, the number there has increased by some nine thousand during the year.

53. It is thought that the following comparative statement of statistics, as furnished by the Department of Native Affairs, will be of assistance in considering your Commission's Report.

Concerning indigenous and other Natives permanently residing in the Colony during					
Year ended	No. of Subsidised Chiefs,	No. of Kraals,	No. of Indigenous Males on Register.	Non-Indigenous Natives registered during the Year.	Average Males (Indigenous & non-indigenous) employed on farms
31st March, 1902	150	11,821	No record.	No record	No record
31st December, 1911	271	13,361	185,143	33,740	37,740
31st December, 1916	280	14,391	215,902	22,125	39,740
31st December, 1921	330	15,270	211,433	37,564	70,740
31st December, 1926	340	17,035	227,990	42,859	133,740
31st December, 1931	356	19,221	252,406	35,516	129,740
31st December, 1932	358	19,494	256,596	31,031	121,740
31st December, 1933	345	18,875	257,337	52,624	125,740
31st December, 1934	352	19,291	261,242	70,967	121,740
31st December, 1935	349	19,757	267,892	71,863	127,740
31st December, 1936	360	20,122	267,717	59,813	137,740
31st December, 1937	359	20,371	271,917	80,901	153,740
31st December, 1938	365	20,363	275,589	61,673	167,740

Year ended	Estimated No. of Cattle,	Estimated No. of Sheep,	Estimated No. of Goats,	No. of Ploughs in use.	Estimated Acreage under Cultivation
31st March, 1902	55,155	60,569	197,477	No record.	534,426
31st December, 1911	330,403	253,318	599,256	3,402	843,334
31st December, 1916	491,522	294,996	693,255	9,245	1,155,586
31st December, 1921	854,498	278,329	783,375	16,913	1,180,460
31st December, 1926	1,197,466	265,458	750,768	27,584	1,204,385
31st December, 1931	1,628,299	288,770	761,583	53,507	1,429,106
31st December, 1932	1,755,610	288,958	785,409	52,273	1,483,338
31st December, 1933	1,748,621	249,876	734,866	66,798	1,549,251
31st December, 1934	1,708,465	245,778	742,226	71,410	1,616,488
31st December, 1935	1,653,462	245,546	745,192	75,338	1,569,067
31st December, 1936	1,547,623	234,769	756,024	79,015	1,388,892
31st December, 1937	1,582,062	243,816	757,703	85,135	1,554,305
31st December, 1938	1,555,806	133,391	743,968	93,938	1,613,773

54. The conditions on which titles to land have been ganted to Europeans have varied from time to time. It is unnecessary to discuss them here, but reference may be made to some of them later when they have a direct bearing on the subject under consideration. For example, the position arising through a farmer being required by his title to allow the taking of wood from his farm by a miner.

V. THE SOIL.

GENERAL OBSERVATIONS ON SOIL EROSION.

55. However valuable the minerals or other resources of this country may be, its fundamental wealth resides in the soil which furnishes man's material requirements and sustains animal and vegetable life, provided there is a sufficiency of lifegiving water.

56. The most important portion of the soil is the surface layer, often only a few inches in depth. It is estimated that, except perhaps in the humid depths of tropical jungles, where growth and regeneration are rapid, it has taken many thousands of years to build up this topsoil. Unfortunately this precious product, which takes so long to build up, can be speedily broken down and dissipated by erosion.

57. Erosion may be regarded as of two kinds. The first is that slow and almost unobserved process which is weathering, wearing down and shaping the earth's surface by the mechanical and chemical agencies of nature. It is generally beyond the control of man, but the wastage of the soil under its action is being continually restored by decomposition and the covering of vegetation. and thus, if left undisturbed, the balance of nature is on the whole maintained. This may be called natural or geologic erosion.

58. The second kind of erosion arises when the intervention of human agencies, or factors controlled by man, combined with the forces of nature, such as wind and water, lead to a destruction and dissipation of the soil process which may be disastrously rapid. This might be called accelerated or induced erosion, but, as it is the only type of erosion being dealt with in this Report, it may conveniently be referred to simply as soil erosion or erosion.

59. Erosion is caused when soil is broken up, denuded or otherwise interfered with and left exposed, without protection, to the action of wind or water. Wind erosion, which has had disastrous results in parts of America, Australia and South Africa, has not yet become a serious problem in this Colony, but may arise if precautions are not taken to guard against conditions such as are developing in certain overgrazed and deforested areas.

60. Erosion caused by water is an insidious disease of the soil. Reference to the attached contour map will show the elevated areas where the principal

rivers have their source. The majority of the population reside in these areas and the chief agricultural and pastoral pursuits are confined to them. From this, and the rainfall map, it will be understood that the considerable volume rain which falls on these elevated parts must in the course of its run off to the rivers, often down steep inclines, have an erosive effect. As long as nature's covering of various growths is allowed to remain undisturbed, the balance of nature is maintained. Where the surface is denuded of its vegetal cover, the effects are serious; where it has been broken up for cultivation and left unprotected they become disastrous.

61. The principal cause of the impairment of the soil is sheet erosion, which consists in the gradual removal of thin surface layers by the runoff from rainfall. This is a process which takes place so slowly that often the farmer's attention may not be drawn to it until the subsoil or rocks make their appearance. Elsewhere Natives are reported to have graphically described this process by saying that the rocks in the land were growing.

62. Once the surface soil has been removed, the erosive action generally advances at an everincreasing rate and the next stage is a form of gully erosion.. (ilullying, being more

spectacular, its evil results are clearly evident and create a greater impression on the mind than the insidious sheet erosion, which is more widespread in its incidence and more disastrous in its effects.

63. Notwithstanding minor local variations, the causes and effects are practically uniform in all countries where soil erosion occurs. Nowhere else have these questions received consideration on such an extensive scale as in the United States of America. It is therefore thought that the following statement by Mr. Bennett, Chief of the Soil Conservation Service there, is deserving of reproduction:-

"The products of erosion are filling stream channels, irrigation ditches, farm ponds and costly reservoirs; accelerated run off from soilstripped, gullyriddled slopes is increasing the hazard of floods, and streams muddied with silt and colloidal clay are being deserted by valuable species of fish. Streams and springs are drying up as the water table sinks to progressively lower levels within watersheds deprived of their capacity to absorb adequate supplies of the rains that fall upon them. Centuries would be required to build back the soil swept from fields and overgrazed pastures of the nation by this process that continues with every rain heavy enough to cause water to run downhill, and with every gust of wind impinging against bare, sun-scorched fields.

More than 75 per cent. of the country consists of sloping land, all of which is potentially subject to erosion wherever used for cleantilled crops or grazed. The average depth of the more productive topsoil on this sloping land is only about 7 or 8 inches. This shallow layer of indispensable natural resource, representing the farmer's principal capital, is being removed bodily at rates ranging generally from about 3 to 20, 60 or 75 years, depending on kind of soil, declivity of the land, rainfall and type of agriculture.

A thriving agriculture is essential to national prosperity. When the rich humuscharged surface layer of soil is stripped from the land, it cannot be restored, even that which has been moved no farther than from the upper to the lower side of the field. Without this productive covering agriculture generally cannot be prosperous, whether prices are up or down. No greater problem than the control of this process and the conservation of the water that causes it confronts the nation today. The problem is national in character and scope. Its injurious effects touch directly or indirectly the interest of every citizen."

64. Many farmers, unaware of the necessity of following as far as possible, nature's ways in preserving nature's balance in building up the essential ingredients of the soil have a pathetic faith in the power of artificial fertilisers to restore crop production in soil denuded land. A Commission appointed by President Roosevelt to enquire into economic conditions in the Southern States recently reported that sixtyone per cent, of the nation's land badly damaged by erosion is in these States; 22,000,000 acres of once fertile soil being ruined beyond repair. The Commissioners attribute this to profligate methods of farming, which, they estimate, results in the annual loss of £75,000,000 worth of topsoil through erosion. They comment on the vain efforts that are being made to restore the land by the application of artificial fertilisers and point to the significant fact that the South, with only one-fifth of the nation's income, pays three-fifths of its fertiliser bill.

65. Having indicated in a general way the nature and evil effects of soil erosion, your Commissioners will now deal with the position in this Colony. First, in the case of land used by Natives and then of that used by Europeans.

VI. SOIL EROSION ON LAND UNDER NATIVE USE.

66. Prior to the advent of the European settler, the Native was largely a hunter and pastoralist. The insecurity caused by intertribal warfare, raids and disputes not only retarded the increase of population but also created conditions unfavourable to the accumulation of great flocks and herds and to the settled conditions necessary to anything but the most rudimentary type of agriculture. There was no inducement to produce crops for disposal to others, and the limited needs of the people were met by the cultivation, with primitive implements, of a few acres of ground, generally consisting of isolated patches carved out of the surrounding bush. The tree stumps were left in the cultivated land. Under these conditions, there was little or no erosion. Since the European occupation a profound change has taken place. From the estimates available it would appear that the indigenous population has trebled between 1902 and 1938, but what is more significant, as will be seen from the statistical figures given in this Report, the number of ploughs has increased from 3,402 in 1902 (no earlier figures are available) to 93,938 in 1938.

67. The Native, especially in places near markets, grows crops for sale. It has been represented that where the distance is not too great to prevent easy delivery the provisions of the maize control legislation, whereunder an attractive cash price is obtainable for maize, have led to greatly increased maize production. Traditional methods of cultivation have largely been abandoned. Extensive areas are broken up by the plough; the general practice being to plough up and down the slope, thus increasing the runoff from rainfall and the consequent erosion of the soil. Formerly, Native crops consisted largely of mullets, ground nuts, sweet potatoes, etc., which, especially in the case of crops planted in mounds, did not conduce to so great a runoff and so much erosion as takes place in maize lands.

68. As is to be expected, the Native is rarely alive to the importance of conserving the soil; his concern is to get crops, with the consequence that the disease of erosion is spreading at an alarming rate where the primitive methods of agriculture have given place to the plough. The accelerated erosion brought about by the plough and the failure to apply any animal manure or other humusforming ingredients to the soil soon renders cultivation difficult and unprofitable. A fresh piece of land is then sought, follows the same course and is in turn abandoned. In proportion as the yield diminishes with the exhaustion of the soil, there is a tendency to maintain the total output by ploughing up an everincreasing area. Reasonably suitable virgin land often becomes difficult to find and recourse is had to the clearing and ploughing of steep hillsides where, owing to the greatly increased runoff, erosion becomes rapid and disastrous.

69. The quest for cultivable land and the desire to get crops on moist land before the coming of the rains have led, in many parts of the country, to the clearing and planting of

river banks and the breaking up of swamps, commonly called vleis. Apart from the question, discussed elsewhere, as to the desirability of protecting these places for other reasons, there is no doubt but their cultivation often leads to serious erosion.

70. So long as the protective growth of trees and other vegetation on the land bordering watercourses is left undisturbed, the highest floods pass over it with impunity, but once these are removed the rich soil, the accumulation of ages, which formerly produced good early pasturage, is readily carried away.

71. In the same way, the breaking up of the natural covering of the vleys leaves them exposed to the destructive forces of the elements. In many cases, little apparent harm is done for many years, but almost inevitably a torrential local downpour sooner or later sweeps over the loosened surface and carries away the rich topsoil. To anyone interested in the country's welfare, there can be nothing sadder than to see once pleasant valleys transformed by this means to barren stretches of gaping dongas. Further remarks on this subject will be found in connection with vleis on land occupied by Europeans.

72. Overgrazing and grass burning will receive separate consideration, but it may be mentioned here that the reduction or removal of the plant covering, however caused, the trampling of the soil by animals and the destruction of its absorptive qualities by clay carried over it in solution and sealing its pores contribute enormously to the increase of runoff. These agencies are at work in many places occupied by Natives, leading to sheet erosion, which, if left unchecked, is followed by gullying and eventually leads to great deterioration, if not actual destruction, of the land.

73. Another fertile source of erosion lies in the numerous tracks caused by cattle travelling, often over great distances, to water supplies and to dipping tanks, as also by the many tracks caused by Native sleighs.

74. It is impossible to state with any degree of certainty the precise extent of the damage caused by erosion in all land occupied by Natives, but this may be, in a measure, estimated from observations made and by a comparison with the conditions in the Native Reserves, in regard to which the following information is available.

75. The evidence before your Commissioners shows that up to 1937 over one and a half million acres of land in the Reserves were badly eroded—that is, by sheet and gully erosion—that in thirteen Reserves 25 per cent. to 50 per cent., and in five 50 per cent. to 75 per cent. of the area is badly eroded. It was further estimated that 16 per cent. of the total arable land in the Reserves had been destroyed by erosion. and that in the eight years prior to 1937 erosion damage, in terms of area, had increased by 60 per cent.

76. Alarming as the extent and rate of progress of soil destruction in the reserves but occupied by Natives, under a system popularly termed " Kaffir farming. ' In the Reserves, there is at least some control through the headmen, chiefs and Native Commissioners, but where "Kaffir farming" prevails there is little or no restraint. The payment by the Native

of the stipulated rent or other consideration appears to be a licence to lay waste the land with impunity.

77. The greater part of the land on which "Kaffir farming" is taking place belongs to companies who permit Natives to settle thereon under the provisions of the "Private Locations Ordinance, 1908," in consideration of payment of rent. These companies are usually represented by local agents whose chief concern is the collection of rent.

78. As already indicated, it is contemplated by the "Land Apportionment Act, 1930," as amended in 1936, that settlement under these rentpaying agreements should not continue beyond the end of July, 1941. These settlements no doubt serve a useful purpose in so far as they provide accommodation which could not be found elsewhere, but they have led to wholesale destruction of land and trees. The settlers have no security of tenure and, in the absence of any incentive from within or compulsion from without to protect or improve the land, but with the inducement to take as much as they can out of it, destruction proceeds apace.

79. As previously mentioned, the estimated Native population on alienated land increased from 184,999 in 1937 to 194,503 in 1938. It is not possible to ascertain with accuracy the number actually settled under the conditions stated in the immediately preceding paragraphs, but from returns furnished to the Commission it appears that at the first of October, 1938, agreements were in existence for the settlement, in terms of the Native Locations Ordinance of 1908, of 23,427 tenants on alienated land. It is estimated that these tenants with their families and followers number about 164,000. In addition to these, there must be a large number of residents living under a variety of arrangements or simply as squatters.

80. Whatever the population in these areas, the amount of destruction taking place in them has only to be seen to be realised. A traveller need not be told when he reaches land that is being "Kaffir farmed." The denuded and dongascarred ground is silent witness to the destruction which has taken place and often forms a striking contrast to land just across the boundary where Nature has been left undisturbed or received considerate treatment. In these areas, there is no effective control of stock. Dipping facilities not being always adequate lead to the driving of cattle to distant dipping tanks, with the attendant trampling out of the soil and vegetation and consequent erosion. It is also stated that the scarcity of trees and grass on these denuded holdings is a fruitful cause of trespass and theft on adjoining land.

81. On many farms owned and occupied by Europeans, farming is also carried on by Natives under a variety of conditions. It may be an agreement to pay rent, supply labour or other arrangement. The general methods of cultivation and consequent erosion do not, as a rule, differ from what is common elsewhere, but in many instances are limited and, in some cases, effective control is exercised by the European occupier.

82. Large areas of land assigned for the purpose of religious missions are occupied by Natives. The Commission had an opportunity of visiting some of these missions and

observing the condition of the land. On a few of them, trained agriculturists were employed and excellent work was being done in teaching the Natives sound methods of husbandry and in demonstrating and insisting upon antierosion methods on the land. In contrast to this, there were instances where the missionaries seemed to take little interest in and no steps to arrest the all too obvious destruction arising from the agricultural and pastoral methods practised by the Natives.

83. It may be that the missionary training and outlook does not always take sufficient account of the problems attaching to the handling of the large areas of land set aside for the use of Natives connected with missions. Your Commissioners are of opinion that a great responsibility rests on the mission authorities to see that this land is not misused. Without interfering with their primary objects, these stations might as some of them now are become useful centres for teaching improved methods of agriculture and the necessity of taking care of the soil.

84. The "Land Apportionment Act, 1930," provides for the prescribing of conditions on which land alienated to individuals in the Native Area shall be held and it is the policy of the Government in making grants to make provision for methods of farming which will protect the land. By virtue of the Government's ownership of the land in the New Native or Occupation Areas, it has power to provide and does make similar conditions when granting rights to occupy land in these areas; but it is feared that, however excellent these conditions, difficulty and failure to exercise adequate supervision under existing circumstances have made them of little avail.

85. Section 27 of the lastmentioned Act permits of Natives occupying Crown land in the European Area on such terms and conditions as the Governor in Council may prescribe. It is estimated that there are some 132,000 Natives living on this land, but it would appear that so far no conditions governing their occupancy have been prescribed. In the absence of any control, it is not surprising that the national assets in their surroundings are fast being ruined.

86. In addition to the Natives who hold land on individual tenure in the Native Area, subject to the restrictions contained in their titles, there is a considerable number who live on this area. There is no special authority for imposing any sort of control on their operations, which are of a generally destructive nature.

87. A considerable number of Natives live in the Forest Area. Their presence is not a serious cause of erosion, but reference will be made to them later as a potential danger to the forests.

88. The Natives in the Undetermined Area, which is of limited extension and in the Unassigned Area, which is sparsely populated and is likely to remain so, do not give rise to any special problem.

89. The result of the laying waste of large areas of land by wasteful methods of cultivation and the increasing number of livestock has been a cry by the Natives for more

and more land. More land would at best be but a temporary palliative as present practices, if allowed to continue, would soon render the whole country wellnigh uninhabitable.

90. In certain cases, large areas of land granted for mission purposes are let in Natives on a rentpaying basis, and, in some instances, conditions not unlike those obtaining under "Kaffir farming" prevail. It may be worth considering whether or not the purposes of the grants are being observed and, if not observed, whether the question of dealing with the land in terms of section 23 of the "Land Apportionment Act, 1930" arises.

VII. MEASURES ALREADY TAKEN TO COMBAT SOIL EROSION ON LAND UNDER NATIVE USE.

91. It may be that with the present rate of increase of the Native population difficulty will be experienced in finding enough suitable land for their requirements, but as it would not only be futile but also highly undesirable to attempt to meet these needs by allocating further areas for uncontrolled exploitation, the obvious course is to adopt measures designed for making the best use of land already assigned to them.

92. The Government has recognised the necessity of getting the Natives to adopt improved agricultural and pastoral methods, and as there will be occasion to refer to what is already being done, not only in connection with soil erosion but also with other matters coming within the Commission's purview, a memorandum prepared by the Agriculturist, Native Affairs Department, on rural development work among Natives is annexed. (Appendix I.)

93. Your Commissioners have had opportunities of meeting the officers concerned with rural development, and were most favourably impressed with their keenness and the amount of work done in a comparatively short time. The task confronting them is formidable and, so far, their activities have, except for minor and advisory work in the Native and New Areas, been confined to the Native Reserves.

94. Erosion and other questions under consideration by your Commissioners being closely associated in the Reserves with what is referred to in Appendix I. as "centralisation," a brief reference to its main features may assist in a better comprehension of these questions.

95. Prior to European occupation, the necessity of selfprotection led to the concentration of the natives in comparatively few kraals, often selected for strategic purposes. The security afforded under present conditions permits of their spreading at will and making their dwellings and selecting land for cultivation with little restraint. This has not conduced to making the best use of the land and, among other results, has been the interference with free grazing range during the growing season owing to the liability of trespass on the numerous widely scattered cultivated plots.

96. The object of centralisation is to bring the Native dwellings together in systematically arranged kraals or villages, having due regard to health and sanitary conditions,

proximity to water and the situation of land suitable for arable and grazing purposes. The arable land, as far as possible, forms a compact unit suitably demarcated for individual use. Where conditions permit, the buildings in the villages are in one or two rows which serve to divide the arable from the pastoral land. According to the Agriculturist for Natives, centralisation surveys had been carried out in respect of 2,407,500 acres up to the end of 1938. Resettlement on about 2,000,000 acres of that area had been completed at that date and it is anticipated that the whole area will have been resettled before the end of the current year. With the present staff about 1,000,000 acres a year can be dealt with. An increase of staff is contemplated which will materially accelerate the work. There are 6,000,000 acres where centralisation is urgent, leaving a balance of 12,592,500 acres where the matter is not so pressing. Among the objects of centralisation are the abolition of the wasteful system of shifting cultivation and encouragement to cultivate smaller areas and increase the crop yields by maintaining soil fertility. Better methods of tillage, approved systems of rotation and protecting the soil against erosion are taught. The question of erosion will be dealt with now; references to other matters relative to centralisation will come in their appropriate places.

97. In 1936, a scheme for soil conservation was adopted for Native Reserves and a Conservation Officer was appointed, together with a number of Native Erosion Control Demonstrators. Antierosion work is proceeding under the Soil Conservation Officer in 10 different Reserves. Up to the end of 1938, a total of 1,141,729 yards of contour ridges had been constructed, 34,004 yards of storm drains dug and 16,087 acres of arable land protected, at an average cost of 3s. 7d. per acre, or £2 13s. 4d. per thousand yards of contour ridges. In addition to the above concerted action, agricultural demonstrators have done a large amount of anti-erosion work throughout the Reserves. According to the estimates of the Agriculturist for Natives, there are about 4,000,000 acres in the Reserves where erosion control work in the form of contour ridging is urgent. Sixteen thousand acres were protected during 1938. At this rate, it would take some 250 years to cope with the situation, but it is hoped that under arrangements now in hand it will soon be possible to deal with 80,000 a year. These figures are based on the assumption that the position remains static, whereas erosion once having gained a hold normally proceeds with an ever-increasing rapidity. From this it will be realised that, even with the proposed increased efforts, there will be great difficulty in guarding against any extension of existing erosion, it will take unremitting efforts to overtake and effectually curb the scourge where it has already got a start. Belated efforts are not only much more difficult and expensive; they are often comparatively ineffective and never can restore the valuable soil that has been carried away.

98. The foregoing figures refer to the Reserves only, where the Natives live under conditions which permit of active measures, of the nature indicated, being taken in their own interests, and where, even in the absence of such measures, the Native Commissioner, chiefs and headmen may, and sometimes do take steps to prevent destruction; but only some two-thirds of the Natives live in the Reserves. A considerable number of the remainder live on land where the Government has no power to exercise control, and, as already indicated, many land-owners, who might do so, appear to be only

concerned with receiving rent and look on the destruction of the land with comparative indifference.

VIII. SOIL EROSION ON LAND UNDER EUROPEAN USE.

99. For a considerable time after the occupation of the country by Europeans their numbers were comparatively small and, owing to unsettled conditions, cattle disease and other causes, few of them settled on the land, and the extent of arable and pastoral farming was insignificant.

100. The gradual extension of the mining industry, the opening of export markets, especially for maize, tobacco and cattle, led to a gradual increase of general farming, but for considerable time questions of erosion and other Wane of the land do not seem to have received much attention.

101. The Honourable Lionel Cripps, who in so doing may be regarded pioneer in more senses than one, wrote an article, published in the Agricultural Journal of August, 1909, on the subject of The Erosion of Soil. The views expressed therein are no less sound now than then. In the opening lines it is stated: "Let us first consider the factors, which, given time and opportunity, are capable of robbing us of the chief asset which we, as farmers and landowners, possess. The asset I refer to is the top twelve inches, more or less, of soil, which furnishes food for the native plants and the crops upon which we are dependent for our living." Certain protective measures are suggested and the article concludes with an appeal to farmers ' . . . to conserve our resources and so order their farming methods that they, while getting good value out of the land, shall leave it to posterity richer and better worth living on than they found it."

102. An early, if not the first, official publication on the subject of soil erosion was the Department of Agriculture's Bulletin No. 400 in October, 1921, entitled Soil Washing. The writer, Mr. A. C. Jennings, Government Irrigation Engineer, dealt with the evils of erosion. Protective measures were recommended, including what, in this Colony, have come to be referred to as "contour ridges." Subsequently, the late Mr. G. H. Rattray and other farmers in the Mazoe district constructed these ridges on their maize land under Mr. Jennings direction. Mr. A. S. Laurie, Somerset Farm, Concession, at once realised on his first visit to the Colony in 1921 the necessity of soil conservation measures, and since then he has done much by precept and example to secure their adoption although at times he felt he was a voice crying in the wilderness.

103. The expansion of the general activities of the country and a profitable market for maize had led to ever increasing areas of rich, virgin land being brought under the plough. Gradually the yields began to decline and, as this was attributed to the diminution of the natural fertility of the soil, recourse was had to the use of artificial fertilisers. Little account was taken of the loss of organic matter and the breaking down of the soil structure, which led to the dissipation of the essential elements by the ever present, although in many cases almost imperceptible, action of sheet erosion. In an effort to maintain or increase their output, some farmers ploughed up natural hollows, hillsides

and narrow valleys between hills and, in a very short time, many acres of valuable pasture and woodland were converted into a dongascarred waste. The best of the Colony's land is in the maize belt. A large area of it had been impoverished by soil erosion, and some of it ruined beyond repair, before remedial measures in the form of green manuring and antierosion works were adopted.

104. Speaking generally, antierosion measures have made slow progress amongst tobacco growers. This want of progress has been attributed by some witnesses to the fact that after two successive crops the land is not used for some years for tobacco growing. A certain amount of indifference as to what happens in the meantime might result in the case of a careless farmer or in one attempting to plant an excessive area, but a doubt as to the effects of contour ridging on the eelworm menace possibly accounts for a hesitation on the part of many to spend money on a project which might, after all, be found to be disadvantageous in another direction. The question will doubtless be settled at the Tobacco Research Station; it is hoped that a decision will not be too long delayed, as some modification of the layout of contour ridges in the case of tobacco areas in the direction of providing a more rapid drainage might, conceivably, result. The question of the relation of contour ridges to the general layout of the tobacco field also requires some consideration.

105. In tobacco growing, the ridge and furrow system is the one in most general use and, as it tends to accentuate the collection of water in depressions, a downhill slope has to be given to promote drainage. Prima facie this would increase the rate of runoff of water. If this is so, what modification of the height and slope of the contour ridge would be necessary? Again it is stated that crossploughing is imperative in tobacco farming. Obstacles such as contour ridges must prove a distinct handicap to such operations. Would it be necessary in the circumstances to adopt strip cropping as a supplement to the contour ridge? These are questions which the Research Station will be able to decide. They are mentioned here in order to emphasize the danger of immediately applying the successful results obtained on the maize farms with contour ridging to somewhat different conditions. Attention to the question should not be delayed, for here too, much, although sometimes almost imperceptible, sheet erosion is in progress (often ending in serious gullying).

106. In the more humid parts of the country there are many swamps, commonly known as vleis. Reference will be made to them later in connection with water conservation and other problems. Regarded in connection with erosion, little harm can be done when isolated patches are broken up for gardens or like purposes, but a grave danger arises either when artificial drainage takes place or where the whole or a large part of their area is divested of the vegetal covering, as happens when they are broken up for wheat or other crops. Many years may pass without anything untoward happening but, sooner or later, there is bound to come that cloudburst or exceptional torrential downpour which sweeps away the soil the accumulated treasure of many centuries which, if left undisturbed or protected and used judiciously, might have been a permanent asset.

107. Erosion due to overstocking and overgrazing has not assumed serious proportions on land occupied by Europeans. Some damage is, however, being done by the driving of cattle to and concentrating them at watering places and dipping tanks.

IX. MEASURES ALREADY TAKEN TO COMBAT SOIL EROSION ON LAND UNDER EUROPEAN USE.

108. Notwithstanding the lessons of other countries and warnings such as that of Mr. Cripps in 1909 and the propaganda initiated against erosion in 1921, little organised effort was made until 1929 when, under the aegis of the Department of Agriculture, 76 miles of contour ridging were constructed, estimated to protect 2,280 acres of land.

109. The growing recognition among farmers themselves of soil erosion as a serious menace is evidenced by a resolution placed on the agenda of the 1931 Congress of the Rhodesia Agricultural Union, a body representative of the farmers of Mashonaland and the Eastern Districts, the chief agricultural areas of the Colony. The resolution was:-

"That this Congress urges on the Government the importance to the country generally of the adoption of a national policy as regards soil wastage from whatever cause, and requests that, at the earliest possible opportunity, steps be taken to enunciate such a policy."

The outcome of this resolution was the appointment of a special committee- "To enquire into the factors causing soil erosion and to formulate suggestions for the prevention thereof."

110. It is interesting to note that there was nothing of a sectional nature in the composition of this Committee, which included not only farmers but also the Chief Irrigation Engineer, the Assistant Chief Native Commissioner, the Chief Road Engineer and the District Railway Engineer. On that account their recommendations, as endorsed by the Union, carry additional weight; that in connection with soil erosion was the appointment of District Soil Conservation Boards, which, in the light of local conditions, would inter alia consider soil conservation matters and report thereon to a Central Soil Conservation Advisory Council, whose functions would be to collate the recommendations of the District Boards and advise the Government on questions of general policy.

111. The movement initiated by the Rhodesia Agricultural Union bore fruit when, in October, 1934, the Minister of Agriculture approved of the appointment of two Soil Conservation Advisory Councils, one for Mashonaland and one for Matabeleland, with the following functions:-

1. To recommend to the Honourable the Minister means whereby the objects of the Rhodesia Agricultural Union's Soil Conservation Committee's report can be achieved as opportunity offers from time to time and to prepare draft legislation for consideration.
- 2.

To carry out propaganda work for the advancement of a national policy of soil conservation.

These Councils have been active bodies. The interest created and propaganda carried out by them in conjunction with the officers of the Government, especially of the Division of Irrigation, have resulted in convincing the majority of farmers in agricultural areas of the urgent necessity of protecting the soil. That Division, with the staff at its disposal, now finds it difficult to keep abreast of the demand for advice and assistance by farmers wishing to carry out protective measures.

112. The following table shows what has been done since 1929 in constructing contour ridges the form of protection most commonly adopted and indicates the increasing interest in the subject:

Year	Miles of Ridge Terracing	Acreage of Land Protected
1929	76	2,280
1930	103	3,090
1931	150	4,500
1932	108	3,240
1923	132	3,960
1934	126	3,780
1935	368	11,040
1936	535	13,375
1937	1,015	25,375
1938	1,742	43,550
	4,355	114,190

The present position is set out in the following excerpt from the Report Director of Irrigation for the year 1938:-

"From records supplied by the Government Statistician it appears that the area of land declared as protected in European areas up to the end of 1937 is 125,010 acres, which is considerably in excess of our official figure given above, as this also includes a certain acreage protected in Native areas.

This would appear to indicate that quite a large proportion of these works are now being set out by the farmer himself.

The figure of 125,010 acres protected, however, only represents 27.2 per cent. of the total area of land under cultivation by Europeans in the Colony, so there is still much leeway to make up before a full measure of protection is assured.

The position is least favourable in Matabeleland, where only 11.4 per cent, of the arable area is protected, whereas in Mashonaland 30 per cent, of the arable area has been protected.

The following schedule showing the relative distribution by districts of cultivated land protected by contour ridges is of interest:-

Percentage of Arable Lands Protected	Number of Districts in Group	Acreage of Cultivated Land	Acreage Protected
Under 5	8	17,765	290
5 and under 10	2	27,851	2,370
10 and under 20	12	114,543	14,130
20 and under 30	6	172,368	47,100
30 and under 40	1	7,888	3,140
Over 40	2	119,055	57,980
	—	—	—
	31	459,470	125,010
	—	—	—

"The two districts with over 40 per cent, protection are those of Gwanda and Mazoe in the Gwanda district it is claimed that there is 100 per cent. protection on the 570 acres of land under cultivation. and in the Mazoe district 48.5 per cent, of the arable area of 118,84. acres is protected."

The division of Irrigation called the Commission's attention to the interesting position that it was only in the districts of Mazoe, Salisbury and Lomagundi that any considerable amount of protective work had been effected that 97,560 acres of land in these districts is protected, i.e., 78 per cent. of the total area of land protected in the whole Colony is situated in the three districts, and that nevertheless this only represents 37 per cent, of the total area of land under cultivation in these districts.

113. Your Commissioners feel that even a partial realization of the benefits of contouring cultivated land would at once lead to its general adoption. A

*** SKIPPED LINE HERE ***

veld, grew heavy crops of maize. In the absence of protection, the topsoil commenced to wash away and proceeded at an everincreasing rate from year to year, with a corresponding decrease in the yield of maize, until in the end it reached some 500 bags for the season, forcing the impoverished family to dispose of the farm and seek pastures new. The farm was acquired by a progressive man who, by extensive protection works and good husbandry has effected a wonderful improvement and brought up the maize yield to round about 10,000 bags for the season.

114. During the past abnormally wet season there were complaints of waterlogging on contoured land, but such an occasional happening is as nothing compared with the evils of erosion where no soil is left on which waterlogging could take place.

X. GENERAL RECOMMENDATIONS AS TO THE PREVENTION AND CONTROL OF SOIL EROSION.

115. It will be gathered from the foregoing survey that, in the comparatively short period of European occupation and owing to the conditions created thereby, much destruction and dissipation of the Colony's most important asset the soil has taken place and that, although what has already been done to arrest it shows an awakening to the gravity of the position, much greater effort is needed if the situation is to be saved. This section will set out the antierosion measures deemed necessary in cultivated land other than land under irrigation and make recommendations as to how they should be carried out. A memorandum prepared by the Division of Irrigation, setting out methods of conserving the soil and water, is attached. (Appendix II.)

116. Nature affords almost a complete protection of the soil under a covering of vegetation. The soil losses are maintained by the normal processes of soil building. When man interferes with this cover, as he must in order to provide himself with the necessities of existence, the balance of nature is at once upset. This may not have serious consequences in the colder humid climates where the crops, mostly cereal, cover the ground thickly and where devastating rains are rare. The position is far otherwise in a country like Rhodesia where crops, such as maize and tobacco, are widely spaced and the intervening soil, generally kept free of vegetation, is exposed to torrential rains.

117. As already stated, wind erosion is not prevalent and may remain of negligible importance in the Colony if care is taken to avoid conditions favourable to its inception, such as are making their appearance in the Fingo Location and certain Native Reserves where, on bare patches denuded of vegetation by overgrazing and the trampling of stock, the loose earth is caught up and carried away by the wind. The position is often aggravated by the trees, which would have afforded some shelter, having been cut down and subsequently kept down by goats, donkeys and other causes. The soil losses caused by water, where nature's balance has been disturbed, can be best minimized by methods directed to controlling the runoff and maintaining the soil in a state as close as possible to natural conditions.

118. The runoff on virgin land is retarded not only by the natural vegetation but also by the highly absorptive nature of the soil resulting from its large humus and organic content. It is therefore important, not only from the point of view of crop yields but also from that of erosion control, to see that any protective measures are accompanied by the maintenance of an absorptive condition of the soil, or, what is almost the equivalent, soil fertility.

119. The conditions under which soil may be broken up and cultivated with least loss largely depend on its nature and situation. In some places it should never be broken up at all and it may even be necessary to preserve its vegetal covering; in others the extent to which cultivation may take place depends on the degree of care the cultivator is prepared to take.

120. In some districts, the Natives' quest for more and more land has transformed once beautifully clad hills into gaunt spectres of ruin. One trustworthy witness instanced a hill, formerly covered with grass and trees, losing every atom of soil and becoming a bare,

rocky mass within three years after having been attacked by Native cultivation. Another witnessan Assistant Native Commissionerstated that the tillage on mountainous country was leading to the washing away of all the soil and complaints by the Natives that they had no land. Localities such as these should be absolutely withdrawn from cultivation.

121. On the lower lvel, the destruction if less rapid is no less sure. Natives, owing to the scarcity or exhaustion of the lower land, are breaking up the hillsides. In a short time, there is little or no soil left. What remains has lost its fertility. The cultivation of such areas should be prohibited unless suitably terraced. In other countries, such as Japan, under similar conditions. where there is no opportunity of moving to another area, the farmer knows that if he loses his soil his livelihood is gone; hence he clings to each handful of it, generally by complete terracing of all his land.

122. Coming lower down still, we reach the areas where erosion, although less spectacular and at first scarcely visible, is causing the most extensive damage. This is on the fiat or moderately sloping land normally used for cultivation both by Natives and Europeans.

123. So long as the Natives using this type of land broke up only small. often isolated, patches with the hoe and left them for another patch when no longer sufficiently productive, they soon became covered with natural vegetation. The soil was not lost and in course of time its virtue would return. With the coming of the plough, the situation changed entirely and headlong destruction set in. The ploughing almost invariably follows the slope of the ground, giving rise to erosion and fast impoverishment or disappearance of all the valuable surface soil. This leads to the ploughing up of another piece of ground, probably even more susceptible to erosion. The comparative statement of statistics given under paragraph 53 shows that the number of ploughs in use by Natives rose from 3,402 in 1902 to nearly 100,000 in 1938. the increase for the last year alone being 8,803.

124. However gentle may be the slope of land being broken up, whether by European or Native, if the plough is used the ploughing should be done on the contour, and it is desirable that planting and cultivation should follow in the same way, as the smallest rut running up and downhill is often the starting point of erosion. There is very little land in this Colony which, in view of the sparsely placed, clean cultivated crops generally grown, does not require some special protection against the torrential rains which are liable to come at any time.

125. Where the slope of the land is moderate, the flow of water may not lead to appreciable erosion, but there is a great danger, unless adequate protection is afforded, when large areas or narrow downhill strips are cultivated on slopes even so slight as to appear to the eye to be level. A method known as strip cropping is recommended in such places, at least as a temporary cheek on erosion.

126. Strip cropping consists, where conditions permit, in breaking up the extent of the cultivated area of land with a main crop liable to erosion, such as maize, with contour

strips of a good hay grass or other close growing crops. The greater the slope the closer these strips should be. They afford a very effective protection, as was shown on an experimental plot in America, where it was found that on land alternately stripped with maize and alfalfa (lucerne) only 1 lb. of soil per acre was lost in 18 months, whereas land, similar in other respects, with maize alone lost 9 tons of soil per acre. Contour strips of virgin veld with its covering of natural vegetation would have the same effect if left in cultivated land.

127. It has been found in the United States of America that rotating erosion inducing crops like maize and cotton with peas, beans, barley, oats or clover, is helpful in protecting the soil. In the absence of such rotations, the system of ploughing in cover crops, such as sunn hemp, is to be commended.

128. The construction of contour ridges is the chief antierosion measure adopted in the Colony. They are most effective in checking sheet erosion, especially on large, cultivated fields. If undertaken and carried out with that object, complete terracing of the land may result.

129. In the absence of any protective measures, the accumulation of water over broad fields, especially after heavy rains, flows down with an erosive effect increasing as to the square of its velocity, resulting in minute gullies, probably only a fraction of an inch in depth to commence with, but growing at everincreasing speed as the rich topsoil is carried away and, if left unchecked, culminating in dongas and ruined land.

130. The design and construction of contour ridges do not require any detailed mention by this Commission. Comprehensive articles dealing with these subjects prepared by officers of the Irrigation Division have been published. Questions bearing thereon are the subject of constant attention by these officers whose advice and assistance are available to all enquirers. The general principle of contour ridging consists in building up banks of soil along the contour of the hillside. These banks are given a very slight slope towards one or both ends of the field, so that surplus water intercepted by them may be carried off laterally at a slow velocity. The distance between the ridges will depend on the slope of the ground, character of soil, etc. It may not be out of place to mention here the necessity of contour ridges being laid out in a proper manner to avoid the great damage which faulty design and construction may entail.

131. The runoff from any higher ground on to the cultivated land should be caught up and carried away by a storm drain. The disposal of the water so collected and that accumulated by the contour ridges, especially if the field is large, often constitutes a serious problem which should be solved before any contouring is undertaken. It sometimes happens that the concentrated runoff may be turned into a natural watercourse, or a depression with an erosive proof covering of vegetation may be available; failing these, it may be diverted and dispersed over grass lands suitable for receiving it without harmful effect. In some cases, it may be stored in darns and from them spread on to the land or put to other uses. Under no circumstances should the runoff simply be diverted from the cultivated land without regard to what becomes of it. If this is done, dongas may

be caused and damage far in excess of any benefit that may have been gained. The Commission's attention was directed to an instance where the discharge of the water from the contoured land was diverted into a vlei, which evidently had not a sufficiently protective covering, and the result was a tremendous donga and irreparable loss. Where an artificial channel is required to receive the runoff, it should be constructed well ahead of the contour work and made erosive resisting by a vegetal covering, stone pitching or other means.

132. The erosion problem is undoubtedly more serious under Native conditions of cultivation than under European. The Commission's recommendations will deal with the former first.

133. It will be realised from the figures which have been quoted that, in the areas occupied by Natives, the destruction being caused to the cultivated land is assuming such alarming proportions that unless effective measures are at once taken to protect it, there may be little left to protect and great difficulty will be found in getting any land on which the Native population can subsist. The application of conservation measures in areas where the Native practice of shifting cultivation is followed would be difficult; it is therefore recommended that, in Native Reserves and other areas where the Government has the necessary powers of control, the first step should be centralisation, and the next the protection of the land from erosion. It is thought that this offers the greatest hope for the preservation of the land and the support of a large population. The following testimony of an experienced missionary as to what has been accomplished in the Selukwe Reserve is worth quoting:

"I believe that the centralisation of lands in Native Reserves is of the greatest importance. I knew the Selukwe Reserve before centralisation was attempted. I knew the state of the Reserve in those days. I had charge of our work in the Selukwe Reserve when centralisation was started and I watched this experiment, and I want to say that I have never in my life seen a finer demonstration of what can be done. It is not sufficient to say that it has revolutionised the lives of these people: it has virtually saved the Reserve and overcome many of the problems which confronted us."

134. It was in the Selukwe Reserve that the first centralisation was undertaken. This was in 1929, when its appalling condition had rendered it scarcely fit for man or beast. When it is remembered that the transformation, to which witness is borne, has taken place without antierosion works, the beneficial effect of centralisation in itself will be realised.

135. The Chief Native Commissioner in his report for 1937 refers to the progress that has been made in centralisation and says, "but we are not getting on with it quickly enough." He then quotes the Agriculturist on the same subject and adds: "In one way or another we shall have to increase this rate." In his evidence before your Commissioners he emphasised the desirability of pushing on with this work, but says that finance and other questions have to be taken into consideration.

136. Your Commissioners recommend that no time be lost in the early institution of an expanded and intensive centralisation and antierosion campaign in all Native Reserves and in any other land set apart for the occupation of Natives on communal tenure. The existing machinery under the Native Affairs Department is a very sound nucleus on which it should be possible to build up an efficient organisation. The experience already gained would be of great assistance in securing rapid expansion without the mistakes and waste often attendant on hasty improvisations. The question of coordinating the suggested organisation with a central authority is considered later.

137. In order to accelerate the protection of the land by contour ridges, the employment of a sufficient number of mechanical units is recommended. In Basutoland, where the work is carried out under conditions much more unfavourable to these units than in this Colony, it has been found that they are more economic than animal traction and the rate at which the work can be performed is very much greater. Working under relatively easy soil conditions in Basutoland, a certain type of caterpillar tractor and grader completed 80,000 yards or 451 miles in a month.

138. It is understood that when the Government grants land to Natives on individual tenure or gives them the right to occupy land under leases or other agreements, conditions are imposed providing for proper methods of husbandry, including the protection of the soil against erosion but, as already pointed out, these will be ineffective unless adequate supervision is exercised.

139. Probably nowhere else is there greater destruction going on than that caused by Native squatters on Crown land and, as previously indicated, where absent European owners let their land to Natives, with an apparent disregard of what becomes of the land and all that is on it. If the removal of the latter class of Natives, as is contemplated in section 24 of the Land Apportionment Act, 1930, had been carried out, or if removal takes place by the end of July, 1941, in terms of the amending Act 31 of 1936, then the end of the bulk of "Kaffir farming" might be said to be in sight. Even assuming that these Natives are removed, the same undesirable conditions may, in a measure, continue not only during the term of existing agreements in respect of a large portion of Matabeleland, which are protected under section 25 of the principal Act, but also be perpetuated where Natives are settled in terms of section 28 of that Act.

140. The position of Natives living on alienated land in the European area, in the circumstances described in preceding paragraphs, constitutes a serious problem. It has been pointed out that a great many of them could not be accommodated in the Reserves or other land set apart for Native use and that any restrictions that would make the letting of land to these Natives less profitable would result in their wholesale ejection. Your Commissioners are of opinion that, if the efforts already initiated to improve the conditions of the Reserves are carried out in the manner and on the scale recommended, this objection will largely disappear. If the result shows that notwithstanding improved methods more land is required for Native use, it is thought that it should be procured.

141. Your Commissioners recommend that the necessary steps be taken to enact legislation clarifying the whole relationship between landowners and Native tenants or occupiers and, among other things, prescribing that the permitting of Natives to live on or use alienated land in the European area must be accompanied by an obligation to conserve the land and other natural resources and a provision making the landowner responsible for the observance of such obligation. As great misuse of land is prevalent on properties where the absentee owners have only a rent collector in the Colony, these owners should be required to appoint a responsible representative in the Colony.

142. Your Commissioners have assumed that in the case of Natives it is the primary responsibility of the Government to take the initiative in providing protective works and carrying out systematic propaganda and training in conservation methods. At the same time, the Natives benefiting from the Government's efforts must be taught their duty to give willing cooperation and assistance. It was very distressing to hear from a senior Native Commissioner that he was obliged to employ alien labour to build dams for the use and benefit of the local Natives. Ordinary maintenance should be an obligation on those directly benefiting from the works. When land is sold to in the iTuxp Area, it is recommended that the necessary protective works be carried out by the Government and the cost thereof added to that of the land. Where Natives occupy Government land under a lease or other temporary conditions, it would not be unreasonable to stipulate that they should take such simple precautions as ploughing and cultivating along the contour; but major protective works should be provided by the Government. Their cost could be taken into consideration in fixing the rent payable.

143. From what has been already stated, it will be seen that there is a growing interest among Europeans in the question of conserving the arable land and that although a good beginning has been made much remains to be done. There is no doubt as to the urgency of the matter not only from the point of view of the farmer but also in the national interest. The difficulty is to decide upon the best means to adopt without imposing undue burdens on the farmer or the State, and to fix a just apportionment of the cost if it is to be regarded as a joint responsibility.

144. In the opinion of some witnesses, reliance should be put on propaganda alone to bring about protection of the land. The desirability of propaganda is generally admitted, but some favour a degree of compulsion where an owner or occupier neglects to protect his land, especially if it results in damage to others. The general view is that farmers, as a rule, are not in a position to shoulder any further burdens unaided and that the Government should give substantial assistance in the constructing of soil conservation works.

145. The following provisions of the Water Amendment Act, 1938, are of interest, especially in that they provide for compulsory protection against erosion in certain cases and enable the Government to construct soil conservation and antierosion works and charge persons profiting thereby a proportion of the cost. So far no action has been taken under any of the provisions of the Act, but they indicate the length to which the Legislature was prepared to go in the matter.

"29. (1) The Minister may appoint soil conservation boards for the prevention of soil erosion arising from the uncontrolled flow, diversion of or other interference with storm water.

(2) Every soil conservation board shall be for a specified area and shall be constituted from persons interested in the prevention of soil erosion. Whenever any such area embraces land of a native reserve or land extensively occupied by natives, a native commissioner or other official of the Native Department shall be appointed to the board constituted for such area.

"30. (1) Soil conservation boards shall, by such means as may appear expedient, demonstrate the evils of soil erosion and encourage owners and occupiers of land and others to prevent the same.

(2) A soil conservation board may recommend the measures to be taken by any person as to the disposal or control of storm water on land or other property in his occupation or under his control which is within the area of such board. If any such person neglects or refuses to carry out any such measures, the board shall report the circumstances to the Minister, who may refer the same to a water court which, after enquiry, shall make such order as may seem fit.

(3) If any person is in default in carrying out any work which the water court has under this section ordered him to execute, the Minister may cause such work to be executed and recover the cost thereof from the person so in default.

31. (1) The Minister may, on or without the recommendation of a soil conservation board, construct soil conservation works, or take such other steps as may appear expedient for the prevention of soil erosion, the cost of which shall be charged to funds provided by Parliament.

(2) Owners or occupiers of land or other persons benefiting by any works or other measures taken in terms of this section may be required to contribute to the cost of the same either by the payment of a capital sum or of an annual rate. Any dispute as to the amount of such sum or rate or any matter connected therewith shall be referred to a water court for consideration and decision.

32. The Governor may make regulations prescribing the duties and functions of soil conservation boards."

146. Your Commission is of opinion that the protection of the soil is of such vital interest to the whole community that the principles embodied in the aforesaid Act are sound, but that power to take action to prevent destruction of the soil should be through a different channel and, in certain cases, taken more directly than provided for in the Act. Recommendations on this head are contained in a later section of this Report dealing with a general scheme of conservation.

147. Your Commissioners recommend that the present propaganda as to the importance of protecting the soil and other national assets not only be continued but intensified, and that the Government accept the liability of subsidizing approved soil conservation works. It is recommended that free grant of 25 per cent, of the cost of such works be made, not in excess of £62 10s., in respect of any unit of land of 3,000 acres or less. It is thought that, in the majority of cases, £250 would more than suffice for the adequate protection of such an area, but considerable expense is sometimes necessary to provide for the harmless disposal of the water accumulated by the protective works. In the Union of South Africa, the Government subsidized antierosion works, in which term farm dams are included, to the extent of 33 per cent. of the cost limited to a maximum payment of £250 per dam and £500 per farm. It is not recommended that dams be regarded as antierosion works except necessarily incidental thereto.

148. Appended to this Report (Appendix III) is a schedule showing the expenditure from votes already incurred in connection with soil conservation on European owned land and the total amount of the loans made for soil conservation works on such land. This schedule also shows the voted expenditure for similar works in the Native Reserves in the year 1938/39 and the estimated expenditure for 1939/40. In addition to this, there has been a total amount of £1,530 from the Native Reserves Trust Funds spent on these works from 1933 to date.

149. As in the case of land under Native use, it is recommended that power units be provided for the speeding up of contour ridging on the land of Europeans. It may be objected that this work is ordinarily confined to a few months of the year and that the plant would be idle for long periods. It is thought, however, that there would be considerable scope for these units throughout the year in such work as contouring pasture land and constructing dams. Many farmers anxious to construct protective works are short of the necessary labour and would be glad to employ and pay for work done by such a unit. In districts where power plants could not conveniently be provided and the procuring of labour is difficult, there would be a demand for trained gangs whose experience has made them proficient in this type of work. In the Gutu district, for instance, witnesses stated that while they would like to protect their land they had difficulty in getting labour for their ordinary requirements.

150. As already indicated, serious soil erosion may take place where vleis denuded of their natural vegetal covering and otherwise unprotected are subjected to heavy floods or downpours. Other aspects of vleis will be dealt with elsewhere, but, as the subject of erosion on cultivated land is now being considered, it seems appropriate to refer here to the breaking up of vleis, especially for wheat growing.

151. A Committee appointed by the Minister of Agriculture and Lands to enquire into the economic position of the agricultural industry, commonly referred to as the Danziger Committee, in its report, presented to Parliament in 1934, quoted a concrete case of 50 acres of wheat on vlei land giving an average yield of three bags per acre; the cost of production was 16s. 3d. and the profit 6s. 3d. per bag. They found, however, that the average yield was 2 bags per acre. For the reasons set out in the report it was

recommended (in respect of all wheat growing) that every endeavour should be made to maintain the price of wheat at 22s. 6d. per bag to the producer and that producers should be encouraged to extend their operations with a view to their being able to provide twice the quantity they were then supplying.

152. No doubt as an outcome of the Committee's recommendations, the Government in exercise of the powers given under the "Customs and Excise Tariff Act, 1926," provided (vide Government Notice No. 709 of 1928) for assistance to wheat growers in the form of a rebate of Customs duty on imported wheat manufactured into flour, provided that the finished product contained not less than 20 per cent. of flour manufactured from Rhodesian wheat. Under this scheme the total cost to the country in respect of the rebate of Customs duties over the eight years 1928-1936 in which it was in operation was £52,287 11s. 4d., an average of £6,535 18s. 11d. a year. From the 1st of October, 1936, onwards the system was changed. The Government, in terms of agreements with the milling companies, buys Rhodesian wheat from the growers at 22s. 6d. on sender's rails and resells it to the millers at a price equal to the ascertained cost of imported soft wheat of a similar quality landed at the milling store concerned, provided that the price payable by the millers shall not exceed 22s. 6d. on sender's rails. These agreements are made from year to year. Under this scheme, the subsidy is the difference in price, if any, and has cost the Government £6,465 8s. for the two full years it has been in operation, and is estimated to cost £15,500 for the year ending 31st March, 1939, an average of £7,321 16s. a year. The total cost to the country for the eleven years has been £74,252 19s. 4d., an average of £6,750 5s. 5d. per annum. The number of growers of wheat on both vlei and irrigated land in 1937 was 523.

153. It is interesting to note that the Wheat Growers' Association represented to the Danziger Committee the cost of production as being as high as 19s. 11d. per bag on vlei land. According to the figures of the Government Statistician, the average production of wheat per acre for the eight years 1930 to 1937, inclusive, is 2.2875 bags per acre. As this includes wheat produced on irrigated land where, according to the aforesaid Committee's findings, the average yield may be 5 bags per acre, it may be that, as stated in evidence to this Commission, the average yield is about 1 bag per acre on vlei land.

154. Your Commissioners are of opinion that, taking the most favourable view of the situation, apart from any other considerations, the growing of wheat on vlei land is, on the whole, economically unsound, and that when it is accompanied, as it often is, by the destruction of valuable vleis, it becomes a tragedy which may be said to be encouraged or even made possible by Government subsidies. These vleis are quite different in character from the swamps found on the red or chocolate soils. They are composed of a mixture of sand and dark undercomposed organic matter, only comparatively rich in humus and plant food. The dark component is not an integral part of the soil complex and can be easily separated from the other constituents leaving a poor, sandy remnant. This is often seen where, on the breaking up of the ground, the dark soil is carried on to the lower portions of the vlei and when floods come is washed down the rivers. In this way, much valuable land is converted into eroded sandy wastes.

155. The subsidizing of wheat growers may have been the means of keeping a number of farmers on the land and inducing further settlement. One result, however, has been widespread deterioration of much land without a corresponding improvement in the status of the occupiers, whose circumstances induce them to take the last ounce out of the soil but preclude them from taking adequate steps to protect it and maintain its fertility. It should not be inferred from the foregoing remarks that your Commissioners see any objection on principle to the subsidizing of wheat growing where the land is suitable and maintained in a condition which will give a good average yield.

156. Much of the land on which wheat is now uneconomically grown is capable of being converted into good pastures. It is recommended that the production of wheat on such land should be discountenanced and that the owners be encouraged to convert their vleis into improved pastures and turn to the keeping of stock. Assistance in lieu of the present wheat subsidy could be given, it being remembered that it would not, as in the case of that subsidy, be recurrent annually.

XI. WATER RESOURCES.

157. In the preceding sections, your Commissioners have dealt with the necessity of the protection of the soil and shown how it is liable to suffer from the uncontrolled flow of water. Without water, however, the richest soil is quite unproductive and, therefore, the questions of soil and water conservation are almost inseparable. Water is an essential to all kinds of animal and vegetable life: the drier the region, the greater the esteem in which it is held. In the religious literature of people living in arid countries, there are frequent references to water as a blessing and to paradise as a place where it is found in abundance.

158. The mean annual rainfall of Southern Rhodesia is in the neighbourhood of 28 inches. The accompanying rainfall map shows that its incidence extreme south of the Colony to over 40 inches in the eastern highlands and in two other elevated areas, one around Selukwe and the other extending from near Zimbabwe to beyond the Native Commissioner's office at Bikita.

159. Southern Rhodesia has a definite rainy season normally extending lie months of October to April. The precipitation during the rest of the year is of little importance. Memoranda by the Director of Irrigation and the Irrigation Engineer for Matabeleland on the subject of soil and water conservation are annexed. (Appendices IV. and V.) From the former it is seen that practically twothirds of the total precipitation occurs during the three months December to February, mostly in the form of showers of heavy intensity. The rainfall is erratic in its annual distribution and there are successions of below, followed by successions of above normal rainfall.

160. Mr. J. S. Peake, B.Sc., in an article published in the South African Journal of Science in November, 1931, in dealing with the 34 years of rainfall then available for Salisbury and Bulawayo, had some interesting remarks on drought periods. Taking a "drought period" to be a period of 10 days or more between 1st November and 25th

March without rain, he found there were 43 in all at Salisbury, 16 of which occurred before the 27th November; only 3 exceeded 20 days. Over the same time, there were 70 drought periods at Bulawayo. One of these lasted 38 days from the 10th December, 1898. There were 7 others lasting over 20 days. These drought periods may be taken as typical of considerable areas in Mashonaland and Matabeleland respectively. The evaporation which takes place during these periods of drought and the runoff from rains have an important relationship to the quantity of water actually available where it falls. The Irrigation Engineer for Matabeleland has calculated that, under conditions in Matabeleland, it is possible to lose more than 10 inches of the rainfall by evaporation from the soil between November and March if a 16day drought occurs once a month.

161. The chief factors influencing the runoff are the general slope of the country, the intensity of precipitation and the degree of absorption by the soil, which is governed not only by the absorptive character of the soil itself but also by the presence or absence of a vegetal covering and by the density of such covering. A study and comparison of the rainfall and altitude maps will show that the chief precipitation and the sources of the principal streams are in the elevated parts of the Colony. It is obvious, therefore, that the general relief of the country and the intensity of the rains provide conditions favourable to rapid runoff.

162. Having regard to the high average rainfall and with a lively recollection of the deluges of the last wet season, there may be some disposition to regard the conservation of water of less importance than it really is. The great variation in the volume of the annual rains, the short period over which they are spread, their intensity and uncertainty of incidence, combined with a high rate of evaporation and rapidity of runoff are all factors which greatly detract from their effectiveness and make their conservation a question of first importance.

163. Owing to climatic and health conditions, presence of water and other causes, the great majority of the population live in the more elevated parts of the Colony where, as has been mentioned, the chief rains fall and the principal streams have their source. Whether or not the runoff of these rains is to be accelerated with a consequent loss of soil and water or is to be retarded with a corresponding profit, largely lies with these people, inasmuch as the chief determining factors in the quantity and rate of runoff and the consequent loss of soil are the management and treatment of the land.

164. President Roosevelt, in a letter to the Secretary of Agriculture on the occasion of a conference on upstream engineering in June, 1936, said the object was "through forestry and land management, to keep water out of our streams, to control its action once in the streams, and generally to retard the journey of the raindrop to the sea." If each occupier of land, whether it be a town stand, suburban lot, farm or ranch, were to set about retarding the journey of the raindrop, he would be promoting not only his own but also the country's interests.

165. Whenever rain of any appreciable volume falls on a bare space it runs off quickly carrying soil with it, thus loss of water and soil go hand in hand. Under natural conditions

the soil is covered with plant or other growth which retards the flow of the water and conduces to its absorption by the soil. Minor experiments carried out in this Colony, more extensive investigations in the Union and most exhaustive researches in the United States of America all point to the important relation the vegetal covering has to water and soil losses. An experiment in the Union showed that the loss of water and soil respectively was 80 to 683 times greater from an uncultivated bare plot as compared with that from a piece of veld left intact. In the United States of America, among many experiments, all pointing the same way, mention might be made of those conducted to determine the losses under varying conditions from thirteen widely separated agricultural soils representative of the principal types of farm land within a predominantly agricultural area of approximately 250 million acres. The measurements were taken over a two to sixty year period, in accordance with the most exact methods known to science, and showed that the loss of water from fields devoted to cleantilled crops was approximately seven times greater than from fields protected with closegrowing crops such as grass, legumes and trees, and further, that the loss of soil from the former was 174 times as much as from the latter.

166. The results in both the foregoing cases were obtained on land such as would ordinarily be used for farming operations. Granted favourable conditions, the runoff and erosion will be greatly increased on the much steeper slopes which largely constitute the catchment areas of our streams. It is, therefore, important that every care should be taken not to promote these conditions and to maintain these areas in a state calculated to induce and retain rainfall. The disappearance of vegetation, whether caused by the destruction of indigenous trees and shrubs, or through the burning or overgrazing of the veld or otherwise, is the most fruitful source of water and soil loss.

167. It is very generally held that widespread destruction of the natural vegetation may even decrease the total precipitation, yet increase its intensity, with a consequent drop in its efficacy. Whatever the truth of this view may be, it has been clearly established by experiences elsewhere that the spread of tillage and stock farming over the catchment areas of streams and the consequent denudation of cover has led to the drying up of springs, the cessation of the permanent flow of the streams and the advent of devastating siltladen floods. While it is imperative to guard against these conditions being allowed to arise, it is encouraging to know that much can be done to combat them when they have arisen. An instance mentioned to the Commission was that of a spring whose good flow decided the authorities to build a dipping tank near it in order that there might be a ready supply of water both for the dip and for the cattle. The congregation of numerous cattle soon destroyed the surrounding vegetation; their trampling consolidated the soil and accelerated the runoff with the consequence that the spring ceased to flow. Someone, inspired by the thought that the position might be retrieved if the original conditions were restored, had a considerable area round the spring enclosed. The vegetation returned and the spring commenced to flow.

168. Great damage is being done by Natives carrying their cultivation into the hills and denuding them of trees and other vegetation. Evidence was given that streams rising in

these hills once clearing and perennial now come down as silt-laden torrents when it rains and cease flowing soon after the rains are over.

169. The breaking up of vleis and of patches of moist ground on river banks has already been mentioned as a source of erosion. In their natural state, these places act as useful reservoirs which stabilize and prolong the stream flow; merely broken up, their humus content and water holding capacity tends to disappear; eroded, they not only cease to be reservoirs but provide channels which drain away the surrounding underground moisture and lower the water table.

170. The catchment areas, the vleis and swamps which stabilize and feed the streams, are of such vital importance to the country that powers should be taken not only to preserve and increase their usefulness, but also, where necessary, to restore it.

171. One of the general powers and duties of the Water Court contained in section 42 of the Water Act, 1927, as amended in 1938, is:

"(e) if required to do so by the Minister, to report for his information as to the measures deemed necessary for the protection of the sources of public streams, whether by the carrying out of works, the preservation of natural vegetation, the method of cultivation of land, the cessation of cultivation of land, or such other means as may appear desirable ;"

The following provisions are also contained in the amended section 108 of the same Act:-

" 108. (1) The Minister shall exercise general supervision over all public streams in the Colony. On a report from a water court he may construct and maintain such works as the court may have recommended and the Minister may deem desirable for the protection of the source of any public stream.

(2) If so requested by the Governor, a water court may enquire into and determine the proportion of the cost of any such protection works which should be borne by persons benefiting therefrom and the proportion which should be defrayed from public funds, and may order any person to carry out the whole or a part of any such protection works which may be for his benefit. If any person fails to comply with such order within such reasonable time as may be fixed by the water court, the Minister may cause the works to be executed and recover the cost thereof from the person in default.

(3) On a report from a water court, the Minister may give such order to any owner or occupier of land as to the preservation of natural vegetation, the method of cultivation of land, the cessation of cultivation of land or such other measures as may have been recommended by the court for the protection of the source of any public stream. Any person who fails to carry out any order of the Minister given in terms of this subsection within such reasonable time as may be fixed by the Minister shall be guilty of an offence."

172. The foregoing provisions of the Water Act, although so far never acted upon indeed they were only promulgated in their amended form in July, 1938 have, in the opinion of your Commissioners, much to commend them and are especially interesting as indicating how far the Legislature, as representative of the people, is prepared to go in providing machinery for the protection of the country's water. As in the case of the soil conservation provisions in the same Act, it is thought that there should be a more direct method of bringing them into operation. Your Commissioners will, in the appropriate place, make recommendations on this head.

173. In addition to protecting catchment areas and other sources of water supply, much can be done in other directions to retain the rainfall on the land and "retard the journey of the raindrop to the sea." When the rains are over and the runoff has ceased, all water, other than that which has been stored, must be sought for in the supply which is found in the ground or issues from it in the form of an ooze or springs. This supply must originally have found its way into the soil; it therefore follows that the more the soil absorbs the better the supply will be, and that the first concern should be to get the rainfall into the ground. To promote absorption, attention need not be directed solely to the surface conditions. The contour ridges and storm drains so useful in preventing soil erosion on cultivated land can, when designed to retain rather than lead water away, be most effective in holding up the rainfall on the land until it finds its way into the ground to augment the subterranean supply. The Commission visited a farm near Inyati where the owner had constructed works to divert floods from the ordinarily dry watercourses and spread them over the veld. With apparent good cause, he was well satisfied with the results.

174. Your Commissioners are of opinion that the ideal conditions for getting the best results in water conservation would be found in a system designed to secure a wise use of both land and water from the headwaters of each rivulet and stream downwards. A wise use of the land implies antierosion measures which will retard the runoff from the rains, leading to much of it being absorbed and stored by the soil and the balance reaching the streams free from silt. As a step towards this ideal, every landowner should be encouraged to construct antierosion works, take all reasonable measures to coax the water into the soil and provide storage dams on all suitable sites where water can be profitably used. The application of such system would go far to sustain stream flow in the dry season and to moderate flood conditions during the rains.

175. There may occasionally be exceptionally good conditions for the storage of large volumes of water, coupled with land suitable for irrigation to which it can be readily applied, may justify the construction of large conservation works. There should, however, be reasonable prospects of a demand for and profitable use of the water. It is thought that almost invariably the large sums of money required for extensive storage schemes could be spent to the profit of a larger number of individuals and to the greater advantage of the community in the furtherance of small conservation undertakings of the nature outlined in the last preceding paragraph.

176. From another point of view, it is undesirable to construct expensive reservoirs unless the catchment, area is not and is not likely to become a source of an undue amount of silt. Under arid and semiarid conditions, tillage and the trampling of stock tends to an accumulation of loose and powdered earth, which is borne down by the first floods, and, if in a catchment area, quickly diminishes the waterholding capacity of the reservoir in which it is deposited.

177. In certain districts in the Midlands of the Cape Province, the silting up of dams is so rapid as to destroy their utility in a few years. In the dry Western States of America the situation is regarded as very serious. Many reservoirs, constructed with a knowledge that they would receive a certain amount of silt and with an estimated life of from 100 to 300 years, will not even last that time. An extreme instance is Lake Austin in Texas, which is estimated to have lost 90 per cent. of its capacity in 20 years. Great efforts directed by a huge staff are being made in the catchment area of the famous Boulder Dam to save it from a similar fate. There could be no better precursor of the construction of a big reservoir than applying the conservation and protection measures described in paragraph 174.

178. Section 3 of the Water Act, 1927. defines 'private water' as:

"All water, not being water of a public stream, which rises naturally on any land or which falls or naturally drains on to any land, so long as it remains on such land and does not join a public stream."

Section 4 provides that:

"The sole and exclusive use of private water shall belong to the owner of the land on which it is found, provided that such use shall be subject to the powers of control vested in a water court under this Act for the purpose of preventing soil erosion."

And section 5 provides:

"All water, other than private water, is vested in the Governor. Its use, diversion and appointment shall be made in terms of this Act and in conformity with any regulations framed thereunder."

179. From the foregoing it will be seen that practically all the water of the country, except that found underground and that which falls in the form of rain before it joins a public stream, is vested in the State, and that its use, diversion and apportionment is made in conformity with the Act and regulations thereunder.

180. The Water Court is the medium constituted by the Act for authorising the use of water and dealing with the numerous questions connected therewith. According to statistics, at the end of 1938 there was existing authority from the Water Court to irrigate 21,654 acres, of which only 11,386 had been irrigated in the course of that year. In 1931, a commencement was made with irrigation projects to serve areas of low rainfall in the

Sabi Valley, inhabited by Natives. Up to date, approximately 5,000 acres of irrigable land are commanded by water obtained under these schemes and work to provide for further areas is proceeding.

181. Some irrigators proceed as if all that were necessary, having got the water, is to turn it on to the land, not appreciating that in applying water they are using a two-edged sword which, unless carefully handled, will do more harm than good by washing away the best of the soil or by waterlogging it. Training and experience are needed in the application of running water to cultivated land, and the more abundant the supply the greater is the danger in using it. The officers of the Irrigation Division, in their contact with European irrigators, are always ready to give general advice as to proper practice, but they are very busy men and much that is needed does not strictly fall within the scope of their duties. It often happens that the land, so situated that it can be irrigated, is small in extent and perhaps the richest or the one rich spot on the farm. If the water is skilfully applied it may be a source of great profit; if through inexperience or carelessness it is allowed to flow uncontrolled, the result may be an eroded waste. There appears to be room for an officer qualified to teach European farmers proper irrigation practice, who, if they fail to follow his teaching, should be liable to have their rights to water cancelled by the Water Court.

182. The extensive irrigation schemes carried out for the benefit of Natives show considerable enterprise and initiative and have provided water at a comparatively small expenditure. They are principally situated in areas of low and uncertain rainfall which, previously, were scarcely habitable and subject to periodical famine conditions. The water, obtained from rivers having their source in places of high rainfall, has been a great boon, but if it is to continue to be the blessing which is desired, great care must be taken to see firstly that the soil is not washed away or deteriorated through its unskilful application, and secondly that the land is maintained in a proper state of fertility. The users of the water are new to this kind of farming and too much should not be expected of them or the Native demonstrators good though many of the latter appear to be. It is strongly recommended that, with a view not only to maintaining but also increasing the utility of these schemes, they be put in charge of trained European supervisors, if through any mischance these enterprises should fail, the last state of those dependent on them will be worse than the first.

183. The only obstacle to the occupation of large areas of the country is the want of adequate water supplies for man and beast. There are several large Native Reserves in Matabeleland in which the population is confined to the limited number of places where they can get water precarious as the supply at times is. During the last few years, the Government has taken active steps to improve conditions by building earthen dams to store the surface runoff and by sinking wells and boreholes chiefly boreholes to draw on the underground supplies. Notwithstanding an improvement in the position, the efforts of the Government are being largely frustrated by the Natives themselves.

184. Once a water supply is provided, the Natives, without regard to the capabilities of the veld, congregate their flocks and herds around it. The grass and other edible vegetation is soon eaten or trampled underfoot and the surface soil is reduced to a

powder. The first heavy rains sweep away this powder and if there are any darns in the catchment area, they soon become silted up. The denudation and trampling of the veld causes a quick runoff and prevents the rain percolating into the soil. A return furnished by the Irrigation Division in respect of nearly 100 boreholes in the Gwaai Reserve shows that a number have gone dry and that the water level in many others has fallen considerably. The greatest recession has occurred in the more populated areas. There is little doubt but an excess of livestock (the subject of overstocking is dealt with elsewhere) by drawing on the water and destroying conditions which tend to replenish it, is gradually exhausting the supply.

185. A notice issued by the Department of Agriculture and Lands on the 31st March last, cancelling one of November, 1936, on the same subject, provides for assistance to the extent of 25 per cent, of the approved cost of water conservation works, carried out in accordance with the conditions therein stipulated and limited to a maximum of £62 10s. It is provided that generally this payment shall only be made once to each owner, but the Minister may, in the case of holdings of extensive area or of more than one holding, approve of additional payments. The last mentioned provision should go far to remove an objection made by the Matabeleland Farmers' Union to the then existing limitation to one payment. The Director of Irrigation favours making the giving of assistance in conservation schemes subject to the grantee carrying out protection works in the catchment area, if such are considered desirable. The Commission, having regard to the varying utility of conservation schemes and the cases where they may be of benefit to more than their authors, is of opinion that each undertaking should be considered on its merits; this could be done by the Central Board recommended later.

XII. FORESTS.

186. It is estimated by the Conservator of Forests that the Colony is wooded to the extent of 60 per cent, of its entire area. In a statement covering certain forestry matters up to 1933, the Conservator classified the forests as Closed and Open. The former he divided into two classes the Mountain Forest and the Fringing Forest, the Mountain type being found, as its name implies, in the mountains on the Eastern Border of the Colony where temperatures are cool and mists and high rainfall occur. In what is commonly known as Savannah forest, belts of closegrowing evergreen trees are found on perennial watercourses or old river beds supplied with flood water these the Conservator of Forests calls 'Fringing Forest.' The Open Forests generally known as Savannah are composed of the more sparsely growing trees which cover the greater part of the Colony.

187. The leading authorities, the world over, are unanimous as to the beneficent effect of the natural forests and the ruin which follows their destruction. In Bulletin No. 25 of the Imperial Bureau of Pastures and Forage Crops, published in 1938, many instances of such ruin are quoted. One is of deforestation in North Africa, converting the fertile cornfields of Roman times into deserts, and cases are cited of the agriculturist, deprived of cultivable soil, turning to keeping goats most potent agents in destroying vegetation. E. Ferrari in his book on "Boschi e pascoli" (Woods and Pastures) says:

"The change that the climate in Persia underwent after the destruction of its numerous and majestic parks is well known; its territory was transformed into movable banks of white sand, the climate became arid and suffocating, springs of water at first decreased and finally disappeared altogether. Egypt, with the devastation of its forests, saw a decrease in rains, in soil fertility, and in uniformity of its climate. Palestine, at one time covered with valuable forests and fertile pastures, possessed also a cool and moderate climate; today its mountains are sadly denuded; the rivers almost dry and crop production reduced to a minimum."

Experience throughout the Old and the New World has been the same.

188. While there appears to be a consensus of opinion as to the general beneficial effects of forests, there has been considerable controversy and divergence of opinion as to their influence on climate, rainfall and in other directions. Your Commissioners have had the views of several witnesses on these matters but, in the absence of adequate scientific data, it is felt that it would be extremely rash to form any opinion on the evidence available to us. Notwithstanding our inability, on the evidence before us, to come to any conclusions on these questions, it is felt that they are of such general interest and importance that it would be of advantage to reproduce here certain authoritative findings of the Fourth British Empire Forestry Conference at Durban in 1935.

189. The Minister of Agriculture and Forestry of the Union, taking advantage of the presence of leading Foresters from all parts of the British Commonwealth, made certain suggestions which resulted in the appointment of a Committee from those present to enquire into the whole question of forest influences, i.e., the effect of forests on climate, water conservation and erosion, with special reference to South Africa and the establishment in that country of forests of exotic species. The Committee's report, signed by ten members competent to treat the subject matter with a high degree of authority, and adopted at a plenary session of the Conference, is entitled to much weight and the findings expressed therein are of such import to this a neighbouring State, that attention is called as briefly as possible to certain of the main conclusions.

I. FORESTS AND CLIMATE.

It was stated in respect of:

(a) Temperature: That observations had shown that forests not only moderate the extremes of heat in summer, but that as a general rule they also modify the extremes of cold in winter and are in this way highly beneficial to man and beast.

(b) Rainfall: That altogether too much credence has been placed in the supposed influence of forests in increasing the total rainfall of a country, but that there is evidence to show that forests have some influence on the local distribution of rainfall, by lowering the temperature of moisture-laden winds and in other ways, and that a judicious location of forests throughout a country is highly beneficial.

(e) Generally: That while afforestation may have only slight bearing on the climatic conditions of a country, the progressive destruction and depredation of vast areas of natural forest result in increasing aridity, the desiccation of the soil and the impoverishment of mankind.

2. FORESTS AND WATER CONSERVATION.

It was stated in regard to:-

(a) Catchment Areas: That some of the most beneficial effects of forests lie in their influence in conserving the supply of water for natural springs and reservoirs and in regulating the flow of streams.

(b) Runoff: That the first influence of the destruction of the forests is on the moisture content of the land, the diminution of perennial streams, the increase of floods, the deposit of detritus by wind and water, reduction of cultivation, followed by man's growing poverty, until he departs leaving a desert behind him.

(c) Springs and Natural Reservoirs: That in general it may be accepted that forests use up a certain amount of soil moisture and, in areas of low rainfall, may exercise a draining influence on the soil; that some eucalypts have a pronounced action in this respect, but that it is unlikely to go deeper than the feeding roots. Referring to complaints received by farmers as to diminished water supplies through planting catchment areas with fast growing eucalypts and pines, the disposition was expressed not to place much credence in these complaints, but the suggestion was made that a comprehensive scientific investigation of the matter would be of value. It was added, however, that to allay public anxiety such plantings should not be made at the actual sources of streams and the eyes of springs.

190. It would be presumption on the part of your Commissioners to comment on the foregoing findings of a body of scientific men thoroughly equipped to deal with the matters under consideration, but it may be added that the views of the Union farmers as to the drying up effect of exotics, especially eucalypts, appear to be not uncommon in this Colony.

191. There is no doubt but the general wellwooded nature of this Colony has been of great assistance in the past in developing its agricultural and mineral resources, but it has led to a wasteful use of indigenous trees, both by Europeans and Natives. These trees have also suffered heavily through veld fires, and although they have come to be regarded on the whole as of low economic value, the Conservator of Forests is of opinion that many varieties now looked upon as of little worth possess useful qualities which seasoning and preservative treatment can enhance.

192. Hitherto the Government's most direct interest in indigenous trees has centred in the variety commonly known as teak; the true name of the type is Umgusu (Baikioea plurijuga). These trees are chiefly found in the deep Kalahari sand country near the

railway line between Bulawayo and Wankie. This country is flat, having an average altitude of about 3,350 feet and a rainfall of 20 to 25 inches. Here are situated the Gwaai Forest Reserve (299,500 acres) and the Ngamo Forest Reserve (291,000 acres).

193. It appears from a minute from the Conservator of Forests to the Secretary, Department of Agriculture and Lands, in March, 1938, that the area estimated to carry productive forest is 567,000 acres, and that of this 303,000 acres have been exploited or committed for exploitation until about 1940. The area available for exploitation from that date is estimated at 304,000 acres, carrying 1,237,000 sound exploitable trees. Concessions for the exploitation of these valuable trees have been granted to commercial concerns. These concessions were given many years ago and it would seem that the Government of the time, no doubt desirous of establishing a new industry and influenced by the representations of those seeking to develop it, was too liberal in the terms granted to the concessionaires. The agreement provided for payment of a royalty on the timber sold. This, as might have been expected, did not give the necessary incentive to economic cutting, and together with lack of organised working in earlier years led to an enormous waste. These concessions are due to expire at an early date, and it is understood that any renewals will be given out on terms which provide for payment on a principle generally adopted elsewhere known as "in the round." A new concession recently arranged embodies this principle.

194. Through bad management, overcutting has taken place to such an extent that, if the present rate of cutting continues, the mature timber supplies will be exhausted within the next dozen years or so, with the result that there would be a break in the industry of from probably fifteen to twenty years until the middleaged trees, which are now unfit for cutting, are mature. The Forestry Department have almost completed a comprehensive survey of the whole of the exploitable teak areas, and it is hoped to induce the concessionaires to curtail their operations and so avoid a break in the industry and the difficulty of restarting it. It is stated that this industry employs some 70 Europeans and 2,000 or 3,000 Natives.

195. It is estimated that the number of exploitable trees, at present, average 5 per acre over the whole area and that middleaged trees which have not quite reached exploitable size are only about 2 to the acre and, as it will probably take them 20 years to reach commercial size, in 20 years' time there will only be 2 mature trees per acre instead of 5 as at present. The Conservator assumes that there has been an increase of veld fires during the last 50 years which accounts for the deficiency of middleaged trees. The growth of saplings is satisfactory and the Department's chief concern is to protect them from fire. With adequate fire protection and other silvicultural work, it is considered possible to bring these areas back to their original productivity. There are further areas which are considered susceptible of reclamation by planting or sowing probably sowing. This could be done comparatively cheaply.

196. Having assumed that any future concessions for the exploiting of the forests will contain proper safeguards against waste, the Commission is of opinion that the Government's chief concern should be to concentrate on its present policy of protecting

these forest. areas from fire. Good results have already been achieved. No financial or other considerations should be allowed to interfere with sustained vigilance lest any temporary slackening of effort should undo the work of years.

197. The presence of Natives in forest areas is not inconsistent with conservation if they are settled on conditions which impose upon them the duty of guarding against fires and other damage; indeed they may serve a useful purpose in assisting in control of fires and trespassers in search of honey, etc.

198. The revenue received in the form of royalties is estimated to reach a total of £76,000 by 1940, and thereafter to amount to £3,600 per annum if managed so as to obtain a sustained yield. The country receives considerable further benefits from income tax paid by the concessionaires and from large sums being spent in the Colony in wages, stores and otherwise. There is no doubt but every care should be taken to preserve and maintain the forests on which this important industry is founded.

199. There are also certain teak forests which fall in areas belonging to land companies which have been let for exploitation. It is thought that all commercial trees thereon will soon be exhausted and it is doubtful whether any steps will be taken to secure a supply for the future. It may be that if the position were explained to the companies by the Forestry Department, they would undertake protection in their own interests and for the benefit of the country, or possibly the Government would consider the question of acquiring these areas for the State.

200. One witness, Mr. MacDougall, General Manager of the Triangle Sugar Estates, at the junction of the Lundi and Mtilikwc Rivers, spoke of the existence of valuable trees, such as pod mahogany, in that neighbourhood and from there onward towards the Portuguese border. The officers of the Forestry Department are not familiar with the area mentioned and it is suggested that it should be inspected.

201. The chief destruction of the indigenous trees of the country takes place in connection with mining and tobacco farming, the generation of power for miscellaneous purposes and the supplying of fuel for domestic use.

202. On the occupation of the country by the British South Africa Company generally referred to as the Chartered Company the minerals of the country were, no doubt, regarded as an asset of the first importance, and it was naturally the policy of the Company to provide facilities for their exploitation. With a view to preventing any obstacles to the obtaining of wood and timber for fuel and other purposes for the mines, provision was inserted in all titles to land reserving to the miners extensive rights to wood, water, etc., and imposing corresponding limitations on the farmer.

203. In the earlier years of settlement, there does not appear to have been the strict discrimination which was afterwards drawn between Gold and Nongold Belt areas, and although the very earliest forms of title reserved all minerals, mineral oils and precious stones to the British South Africa Company and the right of entry in pursuit of the same,

the locating of farms in goldbearing formation was not absolutely prohibited as it came to be afterwards. The restriction of the right to select farms to nonmineralized formations, where the fertility of the land was generally lower, led to considerable agitation and dissatisfaction, which resulted in the Chartered Company deciding about 1905 to permit of the alienation of land to settlers on the Gold Belt area, subject, however, to far-reaching reservations of wood, water and other rights in favour of the miner.

204. The respective rights of miners and farmers have been the subject of much controversy throughout the years and, from time to time, modifications have been made in the law and land titles, generally conceding something in favour of the farmer. The merits of the case between miner and farmer do not per se concern this Commission, for, even assuming that the landowner had an absolute right to the wood and timber, he might sell it to the miner or exploit it in other ways with the same results as exist at present, but it is important to consider whether or not the existing rights enjoyed by prospectors and miners to wood and timber are too comprehensive, having regard to the general interests of the country, or are being exercised in a manner prejudicial to those interests. It may be said at the outset that there was a general recognition by witnesses who spoke on the matter that the mining industry was of such great importance to the country that it should not be subjected to undue restrictions in obtaining indigenous wood and timber for use in mine workings and for generating power for mining purposes where alternate sources of supply were not reasonably available. At the same time, however, representations were made to show that the time has come when the existing rights enjoyed by miners might be modified or exercised in a manner more in keeping with the interests of the whole community.

205. It is impossible to state with accuracy the quantity of wood used by the hulling industry. The Conservator of Forests, basing his estimate of the amount required to generate so many horse power, places it at 200,000 cords a year for power purposes a cord being taken as a pile of wood eight feet long, four high and four wide. He further estimates that this represents the clearing of the equivalent of 40,000 acres per annum. The Conservator is also of opinion that the forest cut over would take 50 to 60 years to regenerate to its former state. He also estimates that it would take 2,000,000 to 2,400,000 acres of indigenous forest to maintain the supply on its present basis. The calculations of the Conservator of Forests as to annual consumption are supported by returns made to the Mines Department. They can be taken as a very fair estimate and denote the extensive scale on which the indigenous forests are being consumed for power purposes on mines. In addition to wood for fuel, timber is used for lagging, pit props, and in other ways in mine workings. It is estimated that some 16,500 cords are used annually for these purposes. This timber has to be selected over a wide area and it would be difficult to state its equivalent in acreage.

206. Before taking into consideration the representations of witnesses as to the desirability of modifying miners' rights to wood and timber or of making provision for their exercise in a manner more compatible with public interests, it may be well to state the existing provisions of the law on the subject as contained in the Mines and Minerals Act, 1935.

207. Speaking broadly, for the purpose of considering the miners' rights to wood, the land of the country may be divided into that alienated under other than Gold Belt title and that alienated under Gold Belt title and Government land. Wood and timber may be taken from land alienated on other than Gold Belt title on such conditions and on the payment of such tariff as may, be prescribed, and from land held under Gold Belt title and Government land subject to no conditions and without any payment. Government Notice No. 339 of 1938 does purport to impose certain conditions in respect of the two last-mentioned classes of land, but they appear to be ultra vires. These general rights may, however, be restricted on any land by the Mining Commissioner reserving all wood and timber or specified wood and timber in a defined area a reservation which he may also withdraw. The principles on which reservations or withdrawals are made are not prescribed. A holder of land under Gold Belt title is entitled under section 13 to have a reservation of half of the wood and timber, all of which he may thereafter use for farming or domestic purposes, or he may dispose of not more than half of it as he pleases and, with the consent of the Mining Commissioner, sell the remaining half to a miner. The principle on which this consent is given or withheld is not clear.

208. It may be said that under the powers conferred by subsection (2) of section 20 of the Act that reservations of trees might be made on account of their intrinsic worth or on account of their situation, say on a watershed, but as far as can be ascertained this is not a purpose contemplated by the Mines Department. That this is so is indicated by no special reservation having been made of the valuable Umgusa forests. Indeed it is understood that concessions to work them specially reserve the miners' rights.

209. It is only in respect of the cutting of wood and timber on land in the first class that conditions can be imposed. Certain regulations have been promulgated under Government Notice No. 573 of the 2nd September, 1935, but they do not appear designed to serve any broad purpose and, in the absence of effective supervision, any good object which they might serve is largely frustrated owing to absence or impracticability of supervision. For example, regulation 7 prohibits the felling of a tree under a certain diameter unless it is required for the building of huts; it might be difficult to prove that a miner cutting timber of a lesser diameter did not intend it for building huts, or that such timber actually being used for other purposes was not from branches of large trees. There is no record of any proceedings for a contravention of this regulation. That the regulations do not seriously aim at the protection of the more valuable varieties of trees may be inferred from the fact that they merely provide a higher tariff of payment for certain of such varieties when used for firewood. Further, it would appear that although valuable timber is cut, there is no evidence of any payment according to the higher tariff being made.

210. Miners enjoy no special privileges as to the taking of wood or timber in the Native Reserves, but they are on the same footing as others who may be allowed to take such forest produce as may be in excess of the present or prospective needs of the Natives, on such terms and conditions as the Chief Native Commissioner may prescribe in terms of the "Native Reserves Forest Produce Act, 1929."

211. Section 12 of the "Forest and Herbage Act, 1936," which empowers the Minister of Agriculture and Lands to make certain regulations for the preservation of trees and other vegetation is as follows:

'12. (1) If he deems it necessary for the maintenance of water supplies, for the conservation of soil, for the protection of roads or other lines of communication, or generally in the public interest, the Minister may, notwithstanding the provisions of any other law, from time to time make regulations, not inconsistent with this Act

(a) prescribing and altering for the whole or any part of the Colony a list of trees and plants which shall not be cut, felled, removed, injured or destroyed save with the special permission in writing of the Minister and on such terms and conditions as may be prescribed by the regulations; and

(b) defining and altering areas in the whole or any part of the Colony wherein it shall not be lawful to graze or depasture cattle or other domestic animals, or to cut, fell, remove, injure or destroy any vegetation whatsoever.

(2) The provisions of any regulations made under paragraph (b) of the preceding subsection shall not apply to private land on which there is a resident European occupier, unless, at the request of the owner of such private land, the provisions have been applied to his land by the Minister by notice in the Gazette. For the purposes of this subsection, "occupier" means the person who has for the time being the legal right of occupying such land."

As far as your Commissioners can ascertain no action has been taken under subsection (1) (a). A regulation framed under section 12 (1) (b) (Government Notice No. 42 of 1938) gives absolute protection to all trees within 200 feet of either bank of a public stream, but, except at the request of the owner, it does not apply to land on which there is a resident European occupier. From this it will be seen that it must be largely ineffective. That it is much disregarded in areas occupied by Natives is evident.

212. From the foregoing review of the law, it will be seen that except in the Native Reserves, and to a limited extent in alienated land under certain forms of title, the miner has extremely wide powers of taking wood and timber for his purposes. Your Commissioners take the view that the Government, having first of all determined what measures are necessary in the national interests for the conservation of the forests of the country, will have to provide machinery for carrying out such measures, which will entail restrictions not only on miners, but on others, and will not have regard to the ownership of the land concerned but to the general interests to be served.

213. Your Commissioners will make recommendations later as to what should in their opinion be provided for in a general scheme of conservation of the forest resources of the country. Attention is now called to the following matters.

214. The raising of steam for generating power by the most wasteful method of wood fuel is still very general. It is suggested that steps be taken to restrict this use in areas where crude oil or power from the Electricity Supply Commission can be procured at reasonable rates. It is thought that in such areas a period should be fixed beyond which the use of wood burning steam plants should be prohibited. In remote areas where timber is plentiful, there seems no alternative to steam plants. They also appear necessary for dewatering operations.

215. A good deal of wood is used as fuel in gas producer plants. This is a much less wasteful method of using wood, as may be instanced by the case of the Lonely Mine, where the substitution of a gas producer for a steam plant resulted in a reduction of the consumption from 3,000 cords of hard wood per month to 600 cords of mixed wood. The abolition of gas producer plants is not recommended in the case of existing plants, but it is thought that the installation of any future plants should be prohibited where electric power is reasonably available.

216. Evidence was given that there is no substitute for wood for roasting plants; it was also stated that this was the only economical fuel for lime burning. With regard to the latter assertion, coal is commonly used elsewhere for lime burning. It appears to be a matter of the design of the kiln. In one locality on the railway line, farm after farm is being stripped of trees for lime burning.

217. In addition to wood for fuel purposes, as already stated, it appears that some 16,000 cords per annum are used in the mine workings. This must be possessed of certain qualities not always readily obtainable. It is therefore regrettable that timber suitable for these purposes is often used for fuel. It is suggested that in certain areas the cutting of mopau trees except for mining poles should be prohibited.

218. In some cases timber for underground workings is brought great distances at a corresponding expense. The miners would be quite willing to buy exotic trees for the purpose, but they state that they are generally unsuitable. This seemed surprising in view of the very extensive use of eucalyptus timber on the Rand mines. With regard to this, some miners stated that the conditions under which the timber was used there were different from those on many mines in this country. On referring the matter to the Conservator of Forests, he was of opinion that there would not be the slightest difficulty in growing timber quite suitable for mining purposes. He stated that hitherto the timber supplied was mostly thinnings or otherwise immature trees which in the course of time would have been capable of meeting any strains imposed on them.

219. Your Commissioners' attention was called to large areas in the Bubi district and elsewhere said formerly to have been parklike in appearance and carrying many fine trees, but now, as a result of cutting by miners and subsequent treatment, covered with an almost impenetrable scrub in places to the exclusion of grass. One farmer, speaking as Chairman of a local Farmers' Association, suggested that miners should on cutting trees be required to take them out by the roots. Even if this were practicable, it is feared that unless every little root were removed the same conditions would soon obtain. This

scrub growth following the felling of certain types of tree is common throughout the country. It is said to be the first stage in a lengthy process of regeneration which, if left to take its natural course, would eventually result in the original condition with a limited number of large trees predominating to the exclusion of the scrub. An early step in this process of regeneration is the springing up of saplings, and the complaint is that these being very suitable for building huts are cut down by the Natives for that purpose. It will be understood that where there are numerous huts, as in mining compounds and other centres of activity, this practice can easily defeat or delay the regenerative process over a wide area, especially when it is remembered that from 250 to 400 saplings are used in a single hut. The first step towards remedying this wasteful practice is the encouraging and, if need be, requiring employers to provide their Native servants with huts having brick or other walls. It is understood this is being done in the Native Reserves under the centralisation scheme and that eucalyptus and other trees are being grown to provide roofing poles.

220. Your Commissioners' attention was drawn to the wasteful method of felling large trees with the intention of using only the branches and leaving the trunks to go to waste. It was further stated that miners, in making contracts for the supply of wood and timber, are in the habit of making stipulations as to sizes, shapes, hardness, etc., with the result that when trees have been felled there is a great part of them left to go to waste after the portions up to standard have been selected. It is felt that steps should be taken to restrict this waste and that, in such cases as the cutting of mining poles, the trash should be brought to the mine for use in the compound to avoid the destruction which usually takes place by the Natives, either by stealth or arrangement with neighbouring landowners, in obtaining wood for their own purposes. It appears that in some cases contracts are entered into with Natives for the supply of wood and timber to mines. It is thought that this is work for which the ordinary Native has not the requisite knowledge or sense of responsibility.

221. With regard to the destruction of trees in the course of farming operations, the Natives, following their traditional habits of shifting cultivation, entailing the cutting down of trees on the land to be cropped and soon abandoned for another piece to be similarly treated, have been responsible for destroying large areas of cultivable land. It must be said, however, that before the advent of the plough and still in places where the primitive methods of tillage are followed, the short period of cultivation of any one piece of ground and the numbers of stumps left were an obstacle to erosion and led to a speedy coppice growth as soon as the land was abandoned, which may be seen in different stages of advancement; some towards forest trees and some retarded by the pernicious system of removing the leading saplings and by veld fires and other causes. The scheme of centralisation, which, among other things, aims at stopping shifting cultivation and the protection of indigenous trees, should go far to redeem the position where the system is operative. This scheme should also lead to the enclosure of the cultivated land by hedges or modern fencing and so dispense with the wasteful cutting down of great numbers of trees to provide barriers against trespass.

222. In the ordinary course the European farmer must clear sufficient land for cultivation, hay fields and other purposes. This may make a considerable inroad upon the trees on arable land, but, as a rule, considerable areas on the hills and elsewhere are left intact if not invaded by the miner. The position is different if the farmer is a tobacco grower.

223. Maize and tobacco are the two principal crops grown by Europeans in Southern Rhodesia. Their respective areas as given by the 1936/37 statistics are 288,000 and 40,700 acres, but the latter figure would have to be multiplied several times to represent the real tobacco area, as the crop cannot be grown continuously on the same piece of land and demands a rotation. Tobacco has now been grown in Rhodesia for a considerable time. The industry received a severe setback in 1928 and the years immediately following owing to the congested state of world markets and the difficulty in disposing of any large quantity of a comparatively new product, but a revival set in from 1932 onwards and with improved prices, assisted by Imperial preference, the area has rapidly expanded and shows signs of increasing still further.

224. The crop is grown mainly in Mashonaland, the chief producing districts being Mazoe and Lomagundi, followed by Salisbury, Makoni and Marandellas, in that order; Hartley and Mrewa being the only two others returning over 1,000 acres under cultivation.

225. The tobacco growing industry is of primary importance to the Colony. The export value of the crop of the season 1936/37 amounted to no less than £1,000,000, but that is not all, for the industry gives employment to large numbers and has made possible the utilisation of large areas unsuited to profitable maize farming.

226. Southern Rhodesian tobacco belongs mainly to the Virginia type. This is grown primarily for the cigarette market, which demands a bright leaf. This fact accounts for the general selection of light soils for tobacco growing. In addition fluecuring is necessary and this process in turn requires large quantities of fuel for drying and conditioning purposes. How large these requirements are may be judged from an estimate by the Forestry Division that 10,000 acres of native timber are used annually in the production of 2,500,000 lbs. of flue cured tobacco.

227. The cutting of native timber for fuel and the neglect of replacing it has led to much unnecessary damage to both soil and woodlands in most tobacco growing areas. The necessity for replanting will be apparent from what actually happens when this is not done. In the early stages of the development of a tobacco farm the clearing of the land provides ample fuel for present requirements, and, where the estate is reasonably wooded, reserves for some seasons in advance. When these are exhausted, the resources of the uncleared portion are next tapped. As the growth of indigenous trees is in general slow, this source of supply eventually comes to an end. Outside supplies have then to be obtained or the farm abandoned altogether, as the land is useless for anything but tobacco. This climax appears to have occurred to a considerable extent in the Umvukwes area, where it is stated that 30 per cent, of the tobacco growers have been compelled to

acquire new farms. It would appear to be the inevitable result if early replacement of timber is not resorted to.

228. In this connection the evidence of one witness may be quoted:

" My next point is the destruction of native timber, which to my mind is one of the tragedies of the country. It is almost impossible to realise the extent to which this has been going on unless one lives in a particular area and compares the surrounding country today with the surrounding country ten years ago. It is deplorable. The reason, of course, is cutting for fuel purposes and also the cutting of sticks for Native huts. For every hut that is built one hundred saplings are cut. So far as remedies go, I should like to suggest that a determined and consistent effort be made by the Government to bring about a partial reafforestation. Very little is being done at the moment."

229. Other areas are possibly affected to a less degree than Umvukwes. It was stated by one witness from another district that the practice of shifting from one estate to another was really a feature of the depression; that it was mainly confined to tenant farmers, and that it is now rapidly going out.

230. Economy in the use of fuel has obviously a direct bearing on the whole question. The older type of furnace requires about two cords of wood for curing 1,000 lbs. of tobacco. This, it is stated, can be reduced to nearly one half by using the most up-to-date types, and while fuel has to be used on the tobacco farms for other purposes, such as in the generation of steam, it is obvious that great economies are possible in this direction alone. We are informed that the use of modern furnaces is making some progress and feel confident that ultimately they will replace the older types once their advantages have been fully realised.

231. Coal has been suggested as an alternative to wood fuel for tobacco curing. This may, be possible for estates conveniently situated as regards the railways (and in some cases is being so used), but for the great majority coal cannot at present rates compete economically with wood obtained or grown on the farms. Unless prices can be reduced either by cheaper freights or lower pithead cost or by both, coal does not offer a solution to the problem. The whole subject of fuel production is one of extreme importance to the future of the tobacco industry. Obviously it is one of considerable concern to the Colony in general.

232. The consumption of indigenous trees as fuel for domestic purposes is not as a rule noticeable on farms where the supply of dead wood is more than adequate, and although in relation to what is available the quantity taken for urban use is not great and with the increasing use of electricity is decreasing, the havoc wrought in procuring it is very striking in the neighbourhood of towns; for example, once beautifully wooded hills at Hunyani Poort near Salisbury are now treeless. In pleasing contrast to the practice of some dealers in firewood, who buy land with the sole purpose of stripping it bare, is the case of one landowner, also near Salisbury, who, by judicious rotational felling, is not only ensuring a constant permanent supply, but is on the whole maintaining the value and

improving the appearance of his woodlands. What has been done by this farmer can be done by others. Measures to prevent the denudation of land, in whatever interests they may be necessary, would fall within the purview of the Board recommended later.

233. Apart from any question of the merits of the case of miner versus farmer, it will be realised that the landowner has hitherto, as a result of the general provisions of the law and of his title in favour of the miner, had little or no inducement to take an interest in the indigenous trees or their preservation, and that on other land, with the exception of the comparatively recent restrictions imposed in Native Reserves by the "Native Reserves Produce Act, 1929," and the limited reservation that may be made under the "Mines and Minerals Act, 1935," and the "Forest and Herbage Preservation Act, 1936," the miner has exercised a virtually uncontrolled right to trees throughout the country irrespective of their species or value. Whether or not this is owing to the spirit and outlook engendered by these or by other causes, the position is that although there is a Division of Forestry, there is not, as in most civilised countries, a Forestry Act designed to conserve and use the country's forest resources in the public interest. Your Commissioners recommend that no time be lost in introducing such an Act, which would vest the supervision and care of all forests on unalienated land in the Division of Forestry. This Division, under a scheme hereinafter propounded, would also cooperate with a central Board in securing the preservation of trees, wherever found, when such course appeared desirable in the public interest. For example, it was represented that the Government should acquire the forests at Mount Selinda in order that they might be preserved in the national interest. There is no doubt as to the desirability of their preservation, but, as they appear to be reasonably cared for at present, it is felt that the question of ultimate control should be left for the consideration of the proposed Board, which, with the assistance of the Forestry Officers, could examine the question from all angles.

XIII. AFFORESTATION.

234. The question of the use of exotic in the place of indigenous timber for mining, tobacco curing and general purposes is of great importance. Evidence as to the exacting requirements of the chrome mines at Selukwe and the dissatisfaction experienced by others who had used exotics for mining purposes raised some doubt in the minds of your Commissioners as to the possibility of making a substitution in the case of mines, but they were reassured by the Conservator of Forests, who had no misgivings in the matter, and also by the fact that, notwithstanding views as to its unsuitability, there is the solid fact that increasing use is being made of locally grown eucalyptus timber. Under these circumstances, there should be no delay in pressing on with the growing of trees suitable for mining purposes. A good beginning has been made at the Mtao Forest Reserve, centrally situated in the Midlands. Timber growing should be a profitable undertaking for private growers, a great assistance to miners and, as in the case of the chrome mines, fine indigenous timber found at great distances from the mines might be preserved with great advantage to the country.

235. The problem of providing fuel for tobacco growers has previously been mentioned. In the case of mines, in the majority of cases the land in their vicinity is not well suited

for growing exotics, but these trees are generally, well adapted to farms suitable for tobacco production provided the requisite knowledge and care is expended on them. There is a disposition on the part of some growers to plant trees on waste land and other places unsuitable to them. It might be a wise measure to institute a campaign to emphasise the necessity of tobacco growers making adequate provision for their future needs in the matter of fuel. This suggestion must not be taken to convey that there is any apathy on the part of the Forestry officials, but the means at their disposal is limited. In this connection, the following extract from the evidence of the Conservator of Forests is quoted:

" We are continually getting at the tobacco farmer to look upon the production of fuel as a necessary part of ordinary tobacco operations. After all, if he has not got the fuel there, he cannot cure his tobacco, and if he has not got sufficient indigenous timber to give him his annual requirements, then afforestation with fastgrowing exotic trees is indicated.

"The solution with the tobacco farmer is much simpler than for the miner, because it is a fact that generally the tobacco growing areas can grow trees. Supposing fastgrowing eucalypts were put down as a fuel reserve: eucalypts are capable, if given proper, fair average treatment and attention, of putting on increment at the rate of two cords per acre per annum and of producing fuel in as little as five years, but we do not advocate such low rotations. If a sevenyear rotation is adopted, that means that in seven years' time an acre of eucalypts can produce 14 cords, sufficient for the curing of 7,000 lbs. of tobacco. So that if we used only eucalypt timber for the curing of the Colony's tobacco crop, it would mean we would need to plant 3,500 acres a year for seven years to produce a total reserve of 25,000 acres and that would cure the present tobacco crop."

236. The industry has been aroused to the necessity of a study of the problems underlying productionthe Tobacco Research Station at Trelawney is evidence of this. Could the same influence which brought about its establishment not be brought to bear in carrying out a campaign to ensure that all tobacco estates make adequate provision for their future needs in the matter of fuel?

237. Propaganda, as in the case of soil erosion, can be very effective in the Colony, but it must not be forgotten that its success has been to a large extent dependent on the provision of technical assistance by Government. It would seem that such is equally necessary in the case of tree planting. The services of the Forestry Department are at the disposal of the tobacco growers so far as advice is concerned, but something more is obviously required. Tree planting must be organised and every tobacco grower must be placed in a position to receive not only expert advice but instruction, which is apparently badly needed, in the proper methods of tree planting and subsequent care of the plantations. One or more Forestry Officers should be specially assigned to the work. Cooperating with local committees of tobacco growers, a systematic campaign could be carried out. If, as has been stated, most growers are willing to plant if they are reasonably sure of a return for their labour and capital, success ought to be assured. One witness stated:-

"There are thousands of trees planted in this country which are unsuitable and it has been a waste of time and capital ... Tobacco farmers are rapidly denuding their farms, and this is not due to lack of wish to plant timber, but to the failures they have had owing to lack of knowledge."

238. Your Commissioners visited the Government's forest plantations at Stapleford on the Eastern border of the Colony. These plantations are composed almost entirely of soft woods and are intended eventually to replace the large quantities of imported timber now almost exclusively used in building and other constructional use. To the eye of the layman these plantations present a wellkept, thrifty appearance and it is satisfactory to know that the Chief Conservator of Forests of the Union, retained in 1935 to examine and report upon them, was most favourably impressed with them. At that time, he and the local Conservator endeavoured to form an estimate as to the annual planting needed in order to meet, if not entirely, then the greater part of the needs of the Colony. They were of opinion that to accomplish this an annual planting of 650 acres would be required. Since this estimate was made, there has been some increase of importations. The statistical information available gives the value but not the quantity of timber imported. The Conservator has, however, from his knowledge of the nature of the imports and of prices, been able to estimate the actual volume of timber brought into the country over the period 1930 to 1937. For the first four years of that period the average annual imports are placed at 757,000 cubic feet and for the last four years at 980,000. In 1937 the figures rose to 1,272,000 cubic feet.

239. Planting commenced at Stapleford in 1929 and since then the annual acreage set out was 450. These plantations will not be in full production for the next 20 years, though it is probable that limited production will start at the end of 12 years. If local requirements increase at their present rate, the planting of 700 acres per annum may meet them at the end of 35 years, but when account is taken of the necessity of making certain experimental plantings, the probable increasing demand as the local hardwoods become exhausted and the possibility of a profitable export market, it seems that there is room for much more extensive planting. The Government having made a good beginning and shown the way, there appears to be a promising field for private enterprise in undertaking plantations on the large areas of suitable land adjoining the Eastern border.

240. In travelling through the Colony, one is struck by the commendable efforts of settlers to establish plantations of trees around their homesteads and sometimes on their farms in forest formation, but a large proportion of partial or complete failure is observable. This can, as a rule, be accounted for by attempting to grow exotics in conditions entirely foreign to their special requirements. It is suggested that not only should advice be sought as to suitable varieties of exotics for the locality but also there should be a campaign to encourage the planting of some of the indigenous types of trees. Some of these indigenous trees have an intrinsic value and many of them are distinctly handsome. They would flourish in places where exotics languish and die. Some of them have a very wide range and appear adaptable to various conditions. For example, there is the so-called Rhodesian wattel (MatabeleUmsehla) (MashonaMusekese), a handsome tree

of considerable intrinsic value, which some members of the Commission saw flourishing at Plumtree and again as far apart as the Umtali district and Warmbaths, in the Transvaal.

241. It was a very common suggestion by witnesses that persons cutting down a tree should plant one or more to replace it. While the spirit prompting this suggestion is appreciated, it is pointed out that more than mere planting is needed; the trees require constant attention until well established, and thereafter protection from fire may be necessary. This might be given by a lover of trees, but could hardly be expected where they are planted under compulsion. More might be accomplished by endeavouring to cultivate a love for trees, as suggested in a later section.

XIV. OVERSTOCKING.

242. Soon after the first rains, unless the soil has completely collapsed through abuse, a prolific crop of grass generally springs up which is capable of sustaining a large number of stock in comfort during the short growing season. As the grass reaches maturity its nutritive properties quickly diminish, and on the approach of winter the carrying capacity of the veld shrinks to a small proportion of its summer value.

243. Correct stocking consists in running as many animals on a certain area as it will maintain in a thrifty condition throughout the year without deterioration of the veld. If that number is exceeded, overstocking takes place and both the land and animals suffer unless special measures have been taken to provide supplementary feed.

244. The carrying capacity of land may be increased either by improving the feeding value of the pasturage itself or by providing additional feed during the months of scarcity. Owing to this Colony's remote situation from the world's markets, the limit to which the production of artificial feeding may go, except in the ease of specialised kinds of farming, such as dairying, is extremely low; it therefore follows that there should be concentration on the less costly course of conserving, improving and making the best use of that great asset, the natural pasturage.

245. Before dealing with the systems of veld management directed to conserving and improving the natural pastures, reference will be made to the general position obtaining today. In the case of animals owned by Europeans there is little overstocking, but in many cases owing to failure to divide the land into fenced paddocks, to adopt rotational grazing and supply adequate water readily available, the incidence of the grazing is liable to fall almost entirely on areas near watering places and on favourite spots where the most palatable feeding is found. Regarded in terms of acreage there is no overstocking, but there is distinct local overgrazing, consequent deterioration of the veld and conditions leading to soil erosion.

246. It is assumed that Europeans are sufficiently alive to their own interests to render unnecessary any external interference to prevent overstocking by them, but it may be that if cases of overstocking arise, some remedy may be found if the resultant evils fall within the provisions of any general conservation law, or if the cruelty inflicted on the animals is

such as to render those responsible for it amenable to the Statutes designed to prevent such cruelty.

247. Owing to unsettled conditions prior to and accompanying the European settlement and disease in subsequent years, the number of Native-owned stock was too few to create the feeding problem which has now arisen. The disappearance of unrest and the provision of means of combating disease which followed settled Government, coupled with the Natives' well-known desire for wealth as expressed in the number of cattle possessed, led to their rapid increase. Statistics show that this increase commenced to slow down gradually for about four years (from 1932 to 1936), after which an upward tendency for one year was followed by a considerable drop in 1938, due partly perhaps to better markets and a growing disposition to sell, but largely no doubt to losses through overstocking. These losses are especially heavy when seasons of good rainfall and plentiful feed are followed by periods of drought and scanty pasturage.

248. The result of overstocking in the Native Reserves and other areas occupied by Natives has been not only the loss of stock but also great deterioration of the grazing ground, much of which has already been brought to a state where rehabilitation appears almost impossible.

249. Before passing to recommendations as to the limitation of stock and the management of the veld, your Commissioners desire to call attention to another factor associated with overstocking and overgrazing, that is the dire suffering experienced by animals when allowed to die slowly from hunger and thirst. This standing reproach to those who directly contribute to it, and to the community in which it takes place, has, it is felt, only to be better realised to be removed or greatly ameliorated. The following somewhat callous view was expressed by a responsible witness:-

"I measure overstocking by the percentage of your cattle that die annually. That is not a fixed figure and in a drought year you get a heavy mortality. I look at it from the point of view of the most economic stocking. One has to stock to a degree that every now and again you get a bad year and the mortality is very heavy."

250. The apparent stagnation and even reduction of the numbers of stock in the case of the Natives as revealed by the statistics is, it is feared, no excuse for complacency, as many of the Reserves are known to have been badly overstocked for some years past and have in consequence suffered severe damage. It is also known that the mortality in recent years has been exceedingly high. The true significance of the statistics would appear to be that nature has taken a hand in the game. It might be said that the best policy in such circumstances would be one of laissez faire, as nature in the end will rectify the balance between stock and feed. But, this view takes no account of the cruelty involved and the effects on the vegetation and soil, for indigenous stock are toughness personified and almost every vestige of vegetation will have disappeared and much of the soil will have been lost before the adjustment is effected. It is this injurious effect on soil and vegetation with which the Commission is primarily concerned, and there is no hesitation in saying that many of the Native areas are heading for ruin through overstocking and that unless

something is done to regulate the numbers of stock in the others, large stretches of land will ultimately become useless. Some alleviation is possible through centralisation and better management, but nature has imposed a definite limit to the amount of stock which a given area can carry and, as has just been said, the indigenous stock are capable of outlasting their food supply and thereby causing irretrievable damage. This applies especially to the drier areas.

251. The question of overstocking in Native areas is a burning one throughout Africa. It exists to a greater or less extent in all territories where cattle keeping is possible and where disease control has been effective. It is primarily associated with the ancient custom of the utilisation of stock not only, as capital investment but as a means of exchange. The system of unregulated communal grazing has also an important bearing on the question, as individual incentive to lighter stocking obviously cannot be present.

252. In Southern Rhodesia, overstocking among Natives must have been of comparatively recent date, for, although sheep and goats were almost as plentiful in 1911 as they are at the present day, the numbers of cattle have increased fivefold since that date. It has been an insidious process, due, no doubt, primarily to effective disease control coupled with the persistence of the habit of putting money into cattle rather than of converting cattle into money. The want of markets and low prices of stock must, however, have played a considerable part, as there appears to be an increasing disposition to sell now that conditions have improved in this respect.

253. Increased voluntary selling by the Natives on a sufficient scale to adjust the balance between the stock and the veld would offer a very acceptable solution of the question. It is thought that it would be of great help in inducing Natives to dispose of their cattle if they could be persuaded to use cash for local purposes and be convinced of the advantages of placing their money in the Savings Bank instead of investing it in stock. To foster such selling, the provision of marketing facilities is of much importance. This is primarily a question of bringing buyer and seller together, and, from the point of view of the latter, the nearer to his home the better it is for him. Purchases are at present largely made by private dealers at the kraals. We are unable to say how far this is satisfactory to the seller. Great difficulty is said to be experienced by salesmen in getting buyers to go to organised sales in the Reserves and it has been suggested that owners might be persuaded to bring in stock to the larger centres. This would require considerable organisation, as it could not easily be arranged on an individual basis and would entail the assembling of animals into droves. The suggestion, however, is well worthy of consideration.

254. Where destocking on any large scale is imperative, it is clear that sales must be conducted on the spot. This has been successfully carried out in several instances in the more congested areas, and, although a great deal of preparatory organisation was entailed, the effort proved well worth while, large numbers being disposed of at reasonable prices: it might well be extended to similarly situated areas. It is obvious that every advantage should be taken of good prices, but care must be taken to guard against flooding the local markets. Perhaps it would be better at the outset to confine such sales to districts which are already overstocked or in danger of becoming so.

255. As previously mentioned, overstocking is not the sole cause of overgrazing. For example, parts of a Reserve may be overgrazed through lack of watering facilities while the rest is undergrazed or even not grazed at all. Efforts are being made to overcome this position by the construction of dams, by the digging of wells and the sinking of boreholes, but, as already indicated, these may bring other difficulties in their train. In some cases there may be the possibility of shifting the stock during the wet months to areas where watering places and feed are to be had during that season of the year and thus saving up the favoured parts for the more difficult times.

256. There is reason to believe that with that patience and sympathy which your Commissioners observed in the dealings of the officials with the Natives much can be done to secure their voluntary cooperation in remedying the evil of overstocking and overgrazing, but there may and likely will be cases where, in the interests of the land and the Natives themselves, compulsory destocking will be found necessary. Legislative authority for such destocking has been made in other States in Africa. Up to now, the compulsory measures taken thereunder are either in their initial stages or have not yet been put into operation; consequently there is not much to be learnt from experience of their working.

257. While there is a consensus of opinion among officials and others competent to speak on the subject as to the necessity of compulsory destocking where other means have failed, there is some divergence of view as to the best method of carrying it out.

258. In dealing with any particular area where destocking has been decided upon, the first step is to determine its carrying capacity. In doing this, it is suggested that if the area is comparatively large, with such local variations of pasturage and other conditions as may be found in the average Native Reserve, it would be undesirable to determine the capacity in relation to the whole area in the absence of uniformity as to the entire grazing incidence. The area on which cattle using the same dipping tank are depastured suggests itself, either alone or combined with one or more similar areas, as a suitable unit for destocking purposes, inasmuch as the actual number of stock carried and the condition of the area are known or easily ascertainable.

259. Where destocking is necessary, it may be assumed that deterioration of the soil and grazing is present, hence it would be necessary to reduce the number of stock to a point where vegetative regeneration could take place; with improved conditions, heavier stocking could again be permitted. From the evidence submitted it is clear that there is much overstocking, and, from what your Commissioners observed, there are some localities where such an acute stage of deterioration has been reached that the only real hope of restoring them is to give them a complete rest for such time as may be necessary. This would, no doubt, entail the wholesale shifting of the population for whom other land would have to be found, but it is a situation that should be faced before all hope of retrieving the position has been lost.

260. Although, as already stated, it is thought that much can be done to bring about a voluntary reduction of the Native stock, your Commissioners are of opinion that not only

in the national interests but also in those of the Natives themselves and in view of illconsidered opposition and criticism which certain officials have been subjected to in trying to bring about such voluntary reduction, it is imperative that legislative provision should be made for compulsory destocking where necessary and where other means have failed.

261. Having determined the number of stock to be allowed on a fixed area, there follows the question of selecting the surplus which is to be disposed of, a problem which will probably be of varying difficulty according to the customs and outlook of the Natives affected. Various suggestions have been made : one is that each owner should submit to a pro rata reduction of his holding, but this system may have complications, such as family ownership. Another proposal is that all the inferior beasts, irrespective of ownership, should be culled until the number allowed for the area concerned had been reached. This is the principle underlying a recent Proclamation in the Union of South Africa (No. 31 of the 14th February, 1939) designed "to combat the evil of overstocking in Native Locations and Reserves and on land held by or from the South African Native Trust." Section 3 (2) of that Proclamation provides that when in the process of culling the demerits of any two animals are considered substantially equal, the animal belonging to the owner of the larger number of stock shall be first culled. In view of the difference of opinion between officials and the absence of any considered views in the case of others as to the best course to be adopted in destocking, your Commissioners recommend that, if the principle is adopted, this and other relative questions be submitted for the consideration of a conference composed of persons specially fitted to advise thereon.

XV. VELD MANAGEMENT.

262. Southern Rhodesia has often been described as a stock rather than an agricultural country. Statistically this statement is true, as it is estimated that 80 per cent, of it can never be used profitably for anything but grazing. Further, there will always remain large portions, especially in the European areas, unsuitable for economic cropping owing to such considerations as uncertain rainfall, shallow soils, excessive slopes and the broken nature of the country. It is equally true, however, that little of the Colony is a readymade stock country, as the growing season is a short one. In the wetter regions there is enough feed and to spare during the summer months, but winter and spring grazing is, in general, poor, while the drier portions towards the south of the territory, where the most nutritious winter grazing is to be found, are exposed to drought and, under natural conditions, demand very light stocking.

263. Were the Colony more favourably situated as regards markets, it could be developed into a good stock country, as the drier portions only require fodder storage and improved water supplies to carry the stock through the lean times, while much of the higher rainfall areas could be developed by a more extensive use of the plough and of shortterm leys. This is on the assumption of good prices. But, owing to the remoteness from the European market (the only one capable of absorbing the products of a properly developed industry) involving a long rail haul in cold storage to the coast, transport charges are so high as to reduce the nett return for first class meat to the value of a very inferior product.

Capital outlay on improvements is thus not the certain investment it would be in the case of a country more conveniently situated as regards markets.

264. In order to provide an outlet for the surplus meat produced in the country and to improve the position of the cattle industry generally, there are cold storage works now owned and supported by the Government. Although the support given is substantial, it is doubtful if this measure alone will, unless accompanied by an improvement in the internal economy of the cattle raising concerns, effect that radical improvement in the general standard of the stock necessary to raise it to a level approximating to that of its competitors in the world's markets. Rhodesia cannot, in the present stage of its development contemplate a position which leaves her with the local market as its main consumer.

265. It is quite evident to all that the question is as much one of feed as of breed. It is merely a truism to say that the welfare of stock depends basically on its adequate nutrition throughout the year and that, in turn, successful stock raising depends on the observance of this principle. As has been already indicated, such nutrition is not to be found naturally in Southern Rhodesia. In the general absence of sufficient continuous natural grazing, a seasonal shortage is experienced and, where no provision is made to meet this, stock suffer in consequence.

266. There is no question but if the expense were justified much might be done in the way of growing crops and making hay and ensilage to provide sufficient feed during the time that the natural pastures are inadequate. It has been found, however, that although the provision of supplementary feed for dairy cows, stud animals and animals held for special purposes may be justified, it is not economic as a general practice. This being the position, the obvious alternative is to consider whether or not better use could be made of the existing natural grasses. In this connection the following words of the Chief of the Division of Plant Industry in the Union, in a preface to a Progress Report on Pasture Research, are very apposite:-

"The veld is the cheapest form of feed and we must rely on it more and more. At present we know little or nothing about the capacity of the veld to produce feed under proper treatment. We do not even know what constitutes proper treatment of the many different types of veld throughout the country. Why is it that the Afrikaner type of beast has held its own amongst all other breeds of cattle that have been introduced ? It is simply because the Afrikaner is able to make better use of the veld than any other animal. The veld has been so badly used in the past that it can no longer be regarded as a stable source of supply. It is steadily declining throughout the length and breadth of the country. The root causes of this decline must be ascertained before remedial measures can be applied."

267. Throughout South Africa two main types of grass are recognised by past pastoralists—sweet and sour, according to their palatability to stock. The latter are generally quick growing and early maturing and, as is normally the case with such types, are of little use for grazing after seeding. Their unpalatability during the greater part of the year in their natural state has obviously earned them their designation as sour grasses, as many

of them are nutritious in their early stages. The sweet grasses, by comparison, are normally of slower growth and, in addition to this, less freeseeding, retaining in consequence their nutritive properties for a much longer period after maturity. The combination of these qualities gives them a much longer useful grazing season than the sour grasses.

268. Pastures are then designated sweet and sour "veld" according to the dominance of sweet and sour grasses found in them, and, as this dominance in natural conditions is dependent on both soil and rainfall, the distribution of sweet and sour veld will follow accordingly, sweet grasses tending to predominate where conditions are favourable to their persistence, viz., in the drier areas and on better soils, while the sour grasses with their early seeding habit have little difficulty in maintaining their existence in the wetter regions, especially on the poorer soils.

269. Complete dominance is, however, rarely met with and a classification into sweet and sour veld is thus not entirely satisfactory. The term "mixed veld" has accordingly come into use to denote grazing where both sweet and sour grasses are naturally present in appreciable quantities. Such intermediate lands ought prima facie to present the best opportunities for grazing purposes as they contain both early and late feeding, but in their case the balance of nature will obviously be more easily disturbed and very careful management be required to maintain it.

270. These are the main categories into which the greater portion of the grazing area of the Colony naturally falls. It will be seen that, from the point of view of their management, widely different problems are involved. From that of their improvement, a still larger number of considerations have to be taken into account.

271. In view of the large area of the Colony unsuited for anything but pasturage, the importance of maintaining or improving its quality can be realised. Your Commissioners, on inquiring what was being done in this direction, learned that the only practical work being carried out was at the Pasture Station at Marandellas under the control of the Agricultural Chemist in collaboration with officers of the Animal Husbandry Division, and certain vlei improvement experiments being conducted jointly by the Department of Agriculture and a local committee of farmers at Rusape. Experiments at the latter station have not been going for a sufficient length of time to produce results, but whatever happens it is obvious that they should be given a reasonably long run for two reasons: in the first place, vlei lands form an extensive area in Mashonaland and any permanent improvement of their grazing capacity, if economically possible, would be of immense benefit to a large number of farms; in the second place, it is necessary in dealing with this type of land to give any apparent improvement a long trial before deciding that it is likely to be a permanent one. This is especially true of drainage and liming, which elsewhere have been known to alter the character of boggy land and produce an entirely new set of conditions, resulting in some cases in ultimate deterioration.

272. In view of the very large area of the country, especially in Mashonaland, where the soil is of granite formation, an inquiry was directed to the Secretary, Department of

Agriculture and Lands, as to what its officers considered the most desirable and practical method of securing the greatest use from the grazing land of a typical farm in this area. In reply to this inquiry a joint statement was prepared by the Agriculturist, the Chief Animal Husbandry Officer and the Chief Chemist. A copy of this statement is appended. (Appendix VI.). The Secretary of the Department of Agriculture and Lands in forwarding it to the Commission expressed his agreement with its terms, but added that a considerable improvement could be secured by constant mowing of wet vleis to encourage regrowth.

273. Notwithstanding the work of zealous officers within their respective spheres, the subject of grazing management of the rough natural veld on which so much depends remains practically untouched. Symptomatic of the cause of this backwardness is the lack of a field botanical staff. That there was once an intention to investigate veld management is suggested by the appointment of a qualified officer, whose post was, however, almost immediately abolished in the general retrenchment following the financial depression in the early years of the present decade. A series of grazing experiments laid down at Matopos in collaboration with the Animal Husbandry staff had to be abandoned, and thus a promising beginning to what would most likely have developed into useful practical work along the right lines came to an end.

274. Yet it seems doubtful if the importance of veld management is sufficiently realised by the Department of Agriculture. In view of the attention directed to the subject in the Union of South Africa in recent years and the promise that investigations there offer, it was desired to ascertain the official attitude to the matter and the following remark was addressed to the Secretary, Department of Agriculture and Lands:-

"Some witnesses laid emphasis on the desirability of getting an ecologist to study veld pasture management."

In reply, the Secretary stated:

" Personally I think it would be useful to have such an officer, but when it comes to deciding whether you pay his salary or have a couple of local technical assistants or an engineer, I think you would get better value from an engineer or the local technical assistants. If money were no object, I would say have the ecologist by all means."

275. In contrast with this view of the subject is the opinion of the Senior Animal Husbandry Officer at Rhodes Matopo Estate, looking at it no doubt from the point of view of the work on which he is engaged:-

"In Southern Rhodesia we know nothing about the management of our pastures and we have not a single qualified botanist in the Department. No work of any importance is being conducted in the Colony.

This unsatisfactory position is certainly, shocking if we take into consideration the fact that the Colony is preeminently a grassland country and that mostSO per cent.of it can

never he used for anything else than grazing stock. Apart from this we are spending annually thousands on soil and water conservation work actually starting at the wrong end as the real remedy for soil erosion and water conservation lies in the control of the vegetal cover."

276. In view of the difference of outlook on the part of two responsible officers, the members of the Commission who visited the Union and Basutoland were impelled to make careful inquiry as to what was being done and the views held there. It was found that in the Union some twenty Pasture Research Stations covering a wide range of country had been established to study the veld conditions of the respective areas where they are placed. A visit was paid to two of these stations in company with the Chief of the Division of Plant Industry, and an opportunity was afforded of discussing various aspects of this work not only with the local officials but also with the Senior Pasture Research Officer, who is responsible for the direction and coordination of their efforts.

277. It is interesting to learn how this extensive pasture research work, which was inaugurated as late as 1934, originated. In May, 1934, the House of Assembly adopted a Resolution:-

"That the Government be requested to institute a proper investigation and take the necessary measures to prevent the drying up of the Union and in general to preserve the waters of the Union and to prevent by legislation or otherwise unnecessary veld burning in the mountains."

278. Following this resolution, proposals to give effect to it submitted by the Departments interested were examined by Heads of Departments and Technical Officers concerned and a comprehensive programme was prepared which resulted in "Pasture Research and Veld Management" becoming one of the main planks in the Government's policy. The results so far obtained are full of promise.

279. Your Commissioners who visited Basutoland were shown three thousand acres of pasture where a system of rotational grazing was being carried out. The improvement in the density and growth in these plots as compared with the surrounding veld was remarkable.

280. Pasture research, which occupies so important a place in the Union and is regarded as necessary in Basutoland, Northern Rhodesia, Kenya and Tanganyika, is surely entitled to instant recognition in this Colony. It is recommended that sufficient stations be established to deal with the predominant types of veld in stockcarrying areas. The cost of building and equipping a pasture research station is moderate. Current expenditure lies mainly in the salaries of the staff.

281. Among the many problems awaiting the Pasture Research Officers is the question of veld burning. On this subject there are many opinions but little reliable information. A very active campaign launched last year by the Secretary, Department of Agriculture, against veld burning was remarkably effective in reducing the widespread conflagrations

which previously had been so common. Although general burning is almost universally condemned, it may be that there are cases where restricted firing is necessary or desirable, but these cases are for the individual immediately concerned and should not detract from the policy which condemns uncontrolled burning. In the furtherance of this policy, propaganda should be continued and further preventive measures adopted. For instance, it is understood that strips along main roads are burned at the expense of the Government but that there is no obligation on local Road Councils to provide similar protection on the roads under their jurisdiction. It seems a reasonable contention that members of a community who contribute to the provision and maintenance of roads to serve their properties should be prepared to unite in making these roads a barrier to protect these properties. This, and other questions relative to the prevention of general veld burning could be suitably dealt with by the Central Board already foreshadowed.

282. One evil of veld burning is that it tends to destroy the humus which enriches the soil and retards evaporation and runoff. The Union Drought Commission, whose final report was issued in 1923, records a case observed by it where after a drought of about seven months a good shower of rain fell over one area, partly burnt and partly unburnt; the dongas on the former all carried water but those on the latter were dry.

283. It would be ideal if the grass could be consumed by stock or converted to hay while still possessed of its nutritive value. However, over large areas of the Colony to graze it while palatable would result in serious overstocking in the ensuing months, and the tree-clad or broken nature of most of the country renders general mowing impracticable. Under these circumstances, there is a mass of dead, worthless grass which, if allowed to accumulate, may choke further young growth, and if it is set alight, as sooner or later it generally is, the result is a holocaust injurious to the surface soil; and if it is a wooded area the younger trees are liable to be destroyed and the growth of the older retarded. In cases of this nature, systematic controlled burning is the reasonable course.

284. There is a great diversity of opinion as to the best time for burning where burning is necessary; some advocate firing in autumn as soon as the grass is sufficiently dry, while against this it is said that the young grass which follows is liable to be killed by frost and an undesirable species of vegetation encouraged. There is a preponderance of opinion in favour of burning after the first good rains of the season, a practice which, in the opinion of your Commissioners, though not free from objections has much to commend it. The old grass cover, having been burnt after serving the purpose of assisting in the absorption of these rains, is soon succeeded by a new growth which has the same beneficial effects.

285. One disadvantage of this burning on wooded veld is the excessive injury to young trees in full flow of sap. One witness, a lover of wild life, stressed the loss caused by burning at this season by the destruction of birds' nests, young birds and animals.

286. In sweet veld areas where the growth is not rank and the grass remains palatable even when dry, there may be little or no necessity for burning, but on the sour veld, especially on granite vleis, there is no question but any accumulation of old grass must be destroyed in order to make place for the new.

287. After mature consideration of the conflicting views expressed by witnesses on the subject of veld burning, your Commissioners are of opinion that general burning might have serious consequences and that therefore the Government's policy to suppress it deserves every support, provided it is not accepted as a condemnation of local burning under all circumstances. This is a subject requiring careful investigation which would come within the province of pasture research.

288. Although there was general recognition of the effectiveness of the antiveld burning campaign already mentioned, some doubt was cast on the usefulness of Native fire patrols. One witness, who keeps well abreast with matters of general farming interest, suggested the adoption of a lorry suitably equipped for fire fighting as used in Australia. This method might receive consideration, if it has not already done so.

289. On commenting on how forest regeneration was retarded or prevented by the destruction of saplings over an area where trees had been felled, attention was incidentally drawn to the extermination of the grass by the excessive coppicing induced by this destruction.

290. Another aspect of tree growth which is making serious inroads on some of the best grazing grounds of the Colony and which is becoming a serious problem is the thorn bush, a variety of acacia which is rapidly encroaching on the sweet veld, especially in Matabeleland. Many places, once excellent grazing grounds, where comparatively recently scarcely a tree or shrub could be found, are being rapidly covered by an almost impenetrable growth of thorn. It is held by some that this phenomenon is in reality part of a natural alternation between grass and bush due to the effect of dry conditions on the two types of vegetation. The commonly accepted view, however, is that the present condition has been brought about by the absence of grass fires owing partly to the consumption of the grass by stock and partly to the protection of the veld from fires. Formerly the seedling thorn trees were destroyed by these fires, but now not only are they protected from them but they are multiplied a hundredfold through the palatable seed pods being consumed by the stock and the seeds passing through their systems and being deposited far and wide over the grazing grounds. For economic reasons, the clearing of heavily thorninfested land is out of the question and at most would only afford temporary relief. This thorn bush encroachment, which is rapidly diminishing the carrying capacity of some of the best grazing in the country, is a grave menace which demands serious attention.

291. Probably in no other direction could expenditure be undertaken to greater advantage than in dividing pasture lands into suitably arranged subdivisions, commonly called paddocks or camps, having regard to the nature of the veld and the water supply. This would permit of a system of rotational grazing whereunder sections would be allowed to recuperate or be closely grazed as circumstances required. It would have the further great advantage of dispensing with the kraaling of stock which often entails long journeys to and from the grazing grounds, the trampling out of the veld, and the formation of numerous erosion paths and wornout patches round kraals. In paddocks stock are spared the strain of these journeys and confinement under conditions often far from comfortable

or sanitary. They are free to rest in the shade in the heat of the day and feed in the cool of the morning or evening, with a better distribution of the incidence of grazing.

292. Much of the benefit of fencing will be lost if the fenced subdivisions are too large and the facilities for obtaining water poor. Some witnesses spoke of paddocks running into upwards of 1.000 acres themselves moderate sized farms. Where watering places are limited, one or more paddocks may be made to converge at a natural supply or a central reservoir, well or borehole from which water can be distributed. It appears that in some parts of America good results have been obtained by arranging the fencing like the spokes of a wheel radiating outwards from a central watering place. Your Commissioners are persuaded that the benefits to be derived from wellplaced fencing are so great that no reasonable effort should be spared to bring it within the reach of all pastoralists, but it is suggested that any State assistance should be subject to subdivisions of the farm being made in an approved fashion. It is thought that landowners might do something themselves in the way of arranging cooperative buying of fencing materials.

XVI. BREEDS OF CATTLE.

293. We have stated that the main problems facing the pastoral industry are as much concerned with feed as breed, but, in emphasising the basic importance of nutrition, the necessity of maintenance of breeds suited to local conditions must not be lost sight of. The question does not at first sight appear to fall strictly within our terms of reference, but it obviously has a direct bearing on the proper utilisation of the grazing resources of the Colony. In the paragraphs immediately following reference is made to cattle only.

294. In approaching the question of breeding, it will be seen that there is a wide divergence in the problems facing the European and Native areas. Dealing first with the European side, it may be truly said that the present position of the stock industry of the Colony, has been attained only through much enterprise, hard work and great perseverance. Great difficulties were experienced at the outset and severe losses incurred among the imported stock necessary for improvement. Large sums had to be spent on buildings and fencing and in the general development of a rough veld into one capable of being at least tolerable to grade cattle. In addition, periods of low prices had to be weathered. From first to last, the bringing of the cattle industry even to its present position has been a long and expensive process.

295. Many of the herds of the country have through prolonged grading reached a stage verging for all practical purposes on that of pure breeds. With this has come the recognition, through experience, that improvement in local conditions must keep pace with grading or, put otherwise, that the latter must not outrun the former. An increasing tendency in the Union of South Africa, and now exhibited in Southern and Northern Rhodesia and in the Bechuanaland Protectorate towards the infusion at intervals of Afrikaner blood into the grade stock, in order to promote hardiness, may be taken as evidence of the appreciation of this fact.

296. To what extent backcrossing with the Afrikaner or other breed such as the Zebu, offers a final solution to the problem is a question which can only be settled by experience. On the face of it, there appears to be no good reason why strictly controlled backcrossing with a purebreed known to possess the qualities which it is desired to transmit should not be successful, but it will take many years to determine the frequency of such operations, and this will obviously vary greatly with local grazing conditions. A radical improvement of these would presumably widen the intervals and, provided there are no other factors than feed involved, might even dispense with the necessity of backcrossing except in rare cases.

297. It has, however, been stated that other factors do enter into consideration. The argument has been advanced that the want of success in acclimatizing British breeds in North and South America within latitudes 30 degrees north and south of the equator is due to inherent physiological

deficiencies for tropical climates. While this has been established for the lower lying regions of the tropics, there is no evidence to show that it applies to a sufficient degree to Southern Rhodesia, with its relatively high altitude and tolerable climate, as to amount to a severe handicap. It is a basic consideration as regards cattle breeding in the Colony and we would strongly recommend its investigation, which should be neither difficult nor expensive to undertake. The subject is admirably discussed in a publication (Pamphlet No. 27, 1932) of the Council for Scientific Research, Commonwealth of Australia, entitled "Zebu (Brahman) Cross Cattle and their Possibilities in North Australia," by H. B. Kelley, B.V.Sc.

298. Dealing now with the improvement of Native stock, we find that the ultimate object should also be to produce an animal suited alike to its environment and to market requirements. The opinion has been advanced that as the local market is the natural outlet for Native stock and as the Natives themselves, whether as employees or otherwise, are the chief consumers, beef quality scarcely enters into consideration, but the fact should not be lost sight of that there are already over 1,500,000 Native owned cattle in the Colony, and with the growing tendency on the part of their owners to convert them into cash, there is a potential danger of the local market being flooded from this source in spite of the present rather easy outlet for all classes of stock. It is also necessary, in the interests of the Natives themselves, to encourage selling, for overstocking, as we have seen, has become a crying evil in many districts. It is thus desirable that Native cattle should be fit for export. The cold storage works, too, require additional numbers for ultimate success. Finally, a ready supply of wellbred Native animals in the early part of the year for finishing purposes would be of great advantage to graziers on sour veld lands and might even assist in the improvement of this type of pasturage.

299. The question can be approached in two different ways: one through selection from the existing stock; the other by following the methods adopted by the Europeans, viz., grading. The former offers the readiest solution and can at least do no harm. Much can be done through eliminating the worst types of huns in the Native areas and retaining only the best for breeding purposes. Provided operations are carried out with discrimination

and the ultimate production of a definite desirable type is clearly kept in view, improvement, although slow in coming, ought to be a reasonable certainty. Progress will depend to a very large extent on the quality of the material available. This will vary from place to place. In many cases, especially where there has been a large admixture of exotic blood, it will be found difficult to find a sufficient number of young male stock good enough for breeding. A nucleus of purebred Native stock of a good type will thus become a necessity and an early beginning should, we consider, be made through the establishment somewhere or other of a Native herd.

300. Improvement through grading will depend entirely on the discovery of a breed the continued use of which will not result in final deterioration as regards resistance to disease and general hardiness. As British breeds are obviously out of the question, it has been suggested that Afrikanders should be introduced into the Native areas. It seems desirable, however, that before such a policy is adopted in Southern Rhodesia the ultimate results of the continued use of Afrikanders should be investigated. This could be effected through concentration on the cattle of a selected community prepared to give the experiment a trial. Such operations should be persisted in through a number of cattle generations before a decision is arrived at. If degeneracy is detected, the trial can be discontinued and good Native animals substituted.

301. It has also been suggested that breeds suited to both local conditions and market requirements can be built up by axing a cross between a Zebu type and a British breed. The success of the King Brahman breed in Texas is instanced. This would certainly be an interesting experiment and, if success were attained, the results would be of considerable value. But the difficulties must not be underestimated. The types are very different as regards both morphological and physiological characters. Regarding the inheritance of these little or nothing is known at present, and the absence of this knowledge renders the fixation of a hybrid correspondingly difficult indeed a matter of luck although at the same time not an impossibility. A tentative examination of the question through actual trial should, we consider, be made before any large scale operations are entered upon.

XVII. MINERALS.

302. Apart from any question as to whether or not the expectations as to the mineral wealth of the country at the time of its occupation were well founded, it may be said that the mining industry has played an important part in the development of the Colony and in times of depression may be said to have been the mainstay of its economic stability.

303. On the constitution of Responsible Government in 1923 and the transfer to it of the administration of the country from the Chartered Company, that Company, having been confirmed in its title to the minerals, continued to exploit them until 1933, when they were acquired by the Government for the sum of £2,000,000.

304. The value of the mineral output during this year (1933) was £3,848,383. Thanks to the stimulus given to mining by the increased price of gold and to the demand for base metals, the value of the country's mineral output rose to £7,482,863 in 1937 and to

£7,695,736 in 1938. The royalty on the mineral output paid to the Southern Rhodesia Government has increased from £96,135 in 1933³⁴ to £188,154 in 1937³⁸. Other direct receipts by the Treasury from mining sources amounted to approximately £56,000 in the latter year. These figures are some indication of the importance of the mining industry to the country. At the same time, it must be borne in mind that inasmuch as mines are wasting assets, it is important to see that they are not unduly wasted.

305. The big increase in the number of small gold producers in the last few years has been remarkable, but a large number of men who have been attracted by the lure of the "yellow metal" and joined the ranks of the smallworkers are men of little or no mining experience. This lack of experience is one of the causes of wastage of the mineral assets. Evidence has been given to the Commission as to the inefficient methods of some smallworkers. These appear in many cases to be owing to limited financial resources, but sometimes they are accounted for by lack of mining and metallurgical experience. This inefficiency, however caused, leads to serious wastage. The cheaper the costs per ton of ore, the more ore there will be economically available for treating and therefore the less the mineral deposit to be left behind when the mine is abandoned.

306. There is in the Mines and Minerals Act no provision as to who may own, manage or work a mine. In the case of the larger mines, chiefly company owned, the Boards of Directors have realised the necessity for having qualified and experienced men in charge of their various operations, but this necessity has not always been realised by the owners of some of the medium-sized mines. The opinion has been expressed to the Commission that there are cases of failure of mines and their consequent closing down, chiefly through mismanagement by nontechnical men. While it is not suggested that there should be any burdensome restrictions on the many unqualified persons in charge of mining operations, it is thought that a system requiring Certificates of Competency for mine managers of all mines over a certain size might be adopted in this country as it has been in the Union of South Africa. The size might be based on the number of Natives employed, and it is suggested that, as a first step, over 300 Natives employed might be a suitable size. It was stated that when this system was adopted in the Union, Service Certificates were granted to managers who had been employed as such for a certain period of time.

307. It appears that a large proportion of the time of Government Mining Engineers is taken up by investigating applications for loans and in supervising mines that have obtained loans, and it is thought that considering the number of producing and developing mines there are in the country, there is not a large enough mining staff. If, however, all mines above a certain size were compelled to have either certificated managers or else be run under the supervision of a competent Consulting Engineer, the Government Engineers would have more time to give to the needs of the real smallworkers and to those inexperienced men who need advice on the best methods of opening ill) and developing mines.

308. Evidence has been given as to the difficulty of reopening some of the old mines, and of the abandonment of some projects because of heavy expense caused by old shafts not

having been adequately protected by pillars, or through these pillars having been removed by previous workers. Mining in its early stages is an apparently wasteful process. The small worker will often open up and work an ore body without paying any particular attention to the needs of the future. However, it sometimes happens that an ore deposit has no depth of economic importance and the outcrop can be completely mined or "gutted" without any loss to the country. In other cases, perhaps due to insufficient financial resources, a miner may give up following his deposit in depth and remove all ore, pillars, etc., along the strike and within reach before abandoning the mine. This practice has in some cases rendered mines dangerous to reexamine and difficult to open up again. A miner, be he engineer or small worker, is usually only prepared to spend a limited amount of money in opening up a mine for examination.

309. The question of access to mine workings is stressed by witnesses as an important one, for the only reliable information about a mine is usually that which the engineer can obtain firsthand. Records left of tonnage and grade are usually unreliable; and assay plans, when available, can often not be depended on. Only personal inspection will assure the engineer that the true reef may or may not have been lost, improperly mined or faulted. It is the opinion of the Commission, therefore, that there should be legal provision for some means of access being left intact in all mines over a vertical depth of 150 feet that may be abandoned or closed down. As a first step towards this, the leaving of adequate shaft pillars should be provided for by the Mining Regulations. These pillars should not be removed, except as another shaft becomes available, or on the permission of the Chief Government Mining Engineer being obtained. This permission should only be granted if the Chief Government Mining Engineer is satisfied that the deposit being mined has come to a definite end and that the Mines Department have full and accurate details of the mine for their records.

310. Section 97 (2) of the 'Mines and Minerals Act, 1935,' calls for all open workings to be filled in or securely fenced in before mining claims are abandoned. In practice shafts are more often filled in. It is the Commission's view that the main shaft at all events should, besides being left intact, be securely fenced and not filled in. This provision should ensure that future mines that may be abandoned can more easily be reopened or reexamined with a view to restarting the mine.

311. There was a considerable body of evidence to show that the incidence of royalty on gold is such that wastage of low grade ore must occur. The view is taken by witnesses that all low grade ore left behind in working a mine may be wasted. An examination of the question is therefore necessary. If a mine is receiving, for example, 20s. per ton with gold at £7 per ounce, at a working cost of 14s. per ton, and assuming residues to be 0.25 dwts. (is. 9d.) per ton, then theoretically any gold ore carrying over 2 dwts. (15s. 9d.) per ton should be payable. Sixteen shilling ore should show a small profit, and if much of this ore is available, it would be used to increase the tonnage treated and so bring down working costs. This is when the royalty factor comes in, for, if the average recovery from the ore treated is 20s., then 6d. per ton royalty may be payable, and this means that every tonne of 16s. ore treated will have been worked at a loss of 3d. per ton. On a large mine of this nature, therefore, this tonnage will be left behind and may be wasted. The higher the

average grade of ore worked, the more the royalty will be and therefore the higher the lower limit of ore payable.

312. Another factor, however, has to be considered and that is the size of the mine. It is found that a mine producing less than £300 per month is exempt from royalty and, therefore, wastage from the cause under investigation will not occur. A low grade mine may decide to increase its tonnage, and then up to £3,000 monthly gross output will have to pay 2 per cent. royalty. After this point, however, the low grade mine owner has to consider the position very carefully before increasing further, as it is possible for the royalty to jump to 5 per cent, before a tonnage of 5,000 tons is reached, when, if the value is not more than 22s. per ton, the royalty becomes reduced to 3 per cent. After this tonnage is reached and if the ore is of a value not exceeding 16s., there is an encouragement to increase the tonnage to over 10,000 per month, so that benefit may be taken of a 2 per cent. royalty taxation in force for that value and tonnage. This examination deals entirely with low grade ore, and it seems that cases of wastage must occur owing to marginal ore being left behind.

313. Under the Mines and Minerals Amendment Act, 1938, provision was made for a Royalty Review Committee to go into any cases of hardship occasioned by the incidence of royalty, and it is understood that many applications for relief have been granted and that the Royalty Review Committee is fulfilling its purpose to a very great extent. It appears that this Committee was formed at the request of the mining industry, who were against any alteration of the old form of royalty taxation on the ground that this taxation was an integral part of their title to work the gold deposits, and any tampering with their titles would discourage capital from entering the Colony. Another objection was that if the principle of altering this tax was once accepted, it might be further altered at the caprice of any Minister of Finance who happened to be in power. The provision of the Royalty Review Committee is considered to be a wise one, and the views of the mining industry on alterations are understandable.

314. It is considered that more encouragement might be given to the opening up and working of new low grade mines. There is the danger that if there is any large fall in the value of gold, it may never come back to its present high level, and if so, ore deposits that might be worked today under favourable taxation, might not be worked under any circumstances and so wasted for all time. There seems no reasonable objection to a sliding scale of royalty in such cases.

315. It appears that latitude should be given to the Royalty Review Committee to lay down definite sliding scales of royalty taxation, preferably on profits, and particularly in the case of new low grade mines. It should be pointed out that the inducement of exemption from taxation for a limited period is not sufficient in these cases and that mine promoters wish to know how the mine will stand as regards taxation for the future, and also will not wish to have alterations made from year to year.

316. Many witnesses stated that the methods of smallworkers in chrome mining were extremely wasteful. Investigation, however, leads the Commission to the conclusion that,

owing to the nature of the chrome deposits along the Great Dyke, if these deposits are to be mined at all, then the present methods are the only ones that can be economically practised. It appears to the Commission, however, that in view of the value of chrome to Rhodesia and the Empire, not sufficient is being done to keep records of these deposits. There may come a time when it will be necessary to open them up at depth. At present the lode is being mined for the most part to a depth of 15 feet or so, and the surface allowed to cave in eventually. It is thought that the Mines and Geological Departments should work together to keep an accurate record of all these workings together with the grade of the chrome ore and width of the seam. This record may at a future date facilitate reopening and working of the Great Dyke deposits.

317. Some of the older countries which probably at one time looked on their coal deposits as practically inexhaustible, now realising that they are strictly limited, are taking stock of the position with a view to prolonging their utility. There is nothing to suggest that the existing coal mines in this Colony are being worked in a wasteful way. The question sometimes raised as to the desirability of opening up other mines was not regarded as falling within the Commission's purview, but it is strongly felt that all reasonable steps should be taken to facilitate and promote the use of coal in place of wood for fuel purposes. The first step would be a reduction in the cost of coal as delivered to the user. In the case of the majority of consumers, the railage amounts to more than the original cost. This is a question meriting the serious consideration of the Railway Commission.

XVIII. NATIONAL PARKS, GAME RESERVES AND OPEN SPACES.

318. In recent years an increasing interest has been shown in the provision of national parks, recreation grounds and open spaces for the health, recreation and, in a measure, the education of the people.

319. One reads from time to time how, in the United Kingdom, each fresh instance of such places being provided for the people by the State, local authorities or public spirited individuals, is applauded. Yellowstone Park in the United States of America, Banff and other national parks in the Canadian Rocky Mountains, and the Kruger National Park in the Union of South Africa, are notable instances of such reservations on a large scale.

320. As a result of the development of the Conservation Movement and the growing desire for national parks in the United States of America, a National Park Service was established in 1917. The Secretary of the Interior in appointing the first Director of this Service made a statement since called the "Magna Charta of the National Parks." This pronouncement, which is deserving of reproduction here and consideration in the setting aside and administering of reservations, is as follows:-

"The administration policy to which the new service will adhere is based on three broad principles: First, that the National Parks must be maintained in absolutely unimpaired form for the use of future generations as well as those of our own time; second, that they are set apart for the use, observation, health and pleasure of the people; and, third, that the national interest must dictate all decisions affecting public or private enterprise in the

parks. Every activity of the service is subordinate to the duties imposed upon it to faithfully preserve the parks for posterity in essentially their natural state. . . You should not permit the leasing of park lands for summer homes Every opportunity should be afforded the public, wherever possible, to enjoy the national parks in the manner that best satisfies the individual tastes All outdoor sports which may be maintained consistently with the observation of the safeguards thrown around the national parks by law will be heartily endorsed and aided wherever possible. The educational as well as the recreational use of the national parks should be encouraged in every practicable way Lowpriced camps operated by concessionaires should be maintained, as well as comfortable and even luxurious hotels wherever the volume of travel warrants the establishment of these classes of accommodations You should encourage all movements looking to outdoor living The national park system as now constituted should not be lowered in standard, dignity and prestige by the inclusion of areas which express in less than the highest terms the particular class or kind of exhibit which they represent."

321. The esteem in which these open spaces are held elsewhere, and the useful objects served, should be an incentive to set aside suitable areas for similar purposes in this young country while land is readily available and its natural beauty largely unspoilt.

322. The only authority in this Colony for making reservations of land for any of the purposes being discussed is the "Game and Fish Preservation Act, 1929," and the "Monuments and Relics Act, 1936". Under the provisions of the first Act the Governor is empowered to define by proclamation reserves within which it shall not be lawful to hunt game without the special permission in writing of the Minister. The following areas have been declared Game Reserves:-

	approximate area in acres
Victoria Falls	134,400
Dett or Wankie	3,220,000
Kasumu Pan	48,640
Robins' Farms	25,398
Matopo National Park	224,000
Chipinda Pools	261,253
Chibi	1,783,000
Sebungwe District	8,116,480
Total	13,814,171

323. The Victoria Falls, Wankie and Kasumu Pan are the only areas properly entitled to be called Game Reserves. The Robins' Farms have been protected by the owner, who has provided for them passing to the Government on his decease. It is understood that when the Chibi area was proclaimed, it was intended to develop it as a Reserve. Nothing has so far been done, but the reservation is being retained for veterinary reasons. Other areas appear to have been declared Reserves with objects other than the preservation of game. Thus the whole of the Sebungwe District was declared a Reserve on account of the desire for keeping hunters out of it owing to the presence of Isetse fly.

324. Some 3.000.000 acres of the Dett Game Reserve and also the large area in the Chibi District fall within the Unassigned area, and may be assigned to either the European or Native Areas. Should a portion or portions be thus assigned, it might be held that notwithstanding the proclamations under other laws, they would become or could be made available for alienation. In actual fact, both areas are situated in localities where, in the absence of water supply and other development, little or no settlement is likely to take place for many years to come.

325. In the Dett Reserve in the Wankie District, active development in the matter of roads, water supplies and camping facilities is being undertaken, and there is a European official in charge. Being close to the direct route by road or rail between Bulawayo and the Victoria Falls, it is likely to be much frequented by Rhodesian residents and tourists from elsewhere.

326. The land known as the Matopo National Park has been nominally reserved since about 1920, but proclaimed as a Game Reserve only since 1930. There is no large game in the area, and the primary object of the reservation of this land has been to ensure an adequate area of vacant land being retained in the vicinity of the grave of the late Mr. C. J. Rhodes, the founder of the Colony. It is broken granite country possessing rare flora and considerable scenic attractions, and its hills contain many prehistoric caves of great archaeological interest. Some portion of the circular drive from Bulawayo to the Grave passes through this Park and proves of great interest to tourists from overseas and elsewhere.

327. Large numbers of Natives have from time immemorial occupied land now embraced with the Park, and from what your Commissioners have seen and the evidence adduced, it appears that very considerable damage has been and is being done in the destruction of native trees and erosion of the soil in the narrow valleys running back into the hills, which formerly contained permanent springs. Early steps should be taken to effect removal of certain of these people and, generally, for the area to be brought under a greater measure of control. Owing to a considerable portion of this area possessing the features mentioned, and in the hope of its reverting to the position when it was the source of permanent streams, it should be fenced off and no occupation permitted therein.

328. All the Game Reserves mentioned, except the Robins Reserve, are situated on Crown land. Resident European Curators or Wardens are stationed in the Victoria Falls and the Dett Reserves, but the remainder are under no direct supervision other than the ordinary Police patrols.

329. Those in the Wankie District (except the Victoria Falls Reserve) and also those in the Ndanga and Chihi Districts contain herds of most of the large and small antelope found in this part of Africa. They are also welltimbered and may be regarded generally as very valuable natural assets to Southern Rhodesia. It is of the greatest importance, therefore, that such steps as are taken in connection with their development should be carried out with the utmost care so that adequate protection is afforded to the wild game, timber and vegetal resources. Once areas are thrown open to the public, very considerable

supervision is required to provide the necessary protection against fire and illegal destruction of game, timber, etc. Your Commissioners can foresee the time when, by affording camping and other facilities, these Reserves can during certain times of the year become veritable national playgrounds, but it would be unwise to afford such facilities until adequate protection and supervision can be given.

330. The categories into which the areas constituting these Reserves fall have been mentioned, as your Commissioners felt some doubt as to whether the mere act of proclaiming them a Game Reserve, which merely prohibits shooting or the destruction of wild life, is adequate to ensure their permanent reservation and perhaps alienation of certain portions, particularly those which are scheduled as unassigned areas under the "Land Apportionment Act, 1930."

331. It is understood, however, that in a debate in the Legislative Assembly on the 12th April, 1933, the Government accepted the following motion:-

"That any Game Reserve now in existence or to be created in the future as a sanctuary for the protection of game, shall continue to be a national Game Reserve until authority is obtained by resolution of this House to abolish it."

Further, the Government is a signatory to the International Convention for the Protection of Flora and Fauna in Africa, and one article of the Convention lays down that no National Park shall be alienated without approval of the competent legislative authority.

332. In addition to these larger reservations, it is considered there is perhaps a need also at this stage of the country's development to reserve a certain number of smaller areas not too remote from the larger urban centres, which could be retained in their natural state and provide attractive weekend camping places for town dwellers, organised parties of school children, and others. It is thought to be very desirable for children growing up in African colonies to have facilities to develop a true love of country life and the beauties of nature, and to learn to know the names of the indigenous trees, wild flowers, grasses, etc., of their own land.

333. To travellers by road, especially those coming from comparatively treeless regions, it is very pleasing to have treelined roadsides. It is recommended that the indigenous trees bordering on public roads, at least on the reserved strips adjoining the actual highway, be preserved.

334. It may be that owing to the number of vacant building sites and the broad streets in Rhodesian towns, the value of open spaces is not sufficiently appreciated. It is therefore recommended that the need for these be borne in mind and that even if it is not considered necessary to provide more, any encroachment for whatsoever purpose on the existing parks or open spaces dedicated to the public be strongly resisted.

335. Under the "Monuments and Relics Act, 1936," the Minister may proclaim certain things to be "national monuments." These include areas of land of archaeological or

historical interest or containing objects of such interest, or which have distinctive or beautiful scenery or a distinctive geological formation, or which contain rare or distinctive or beautiful flora or fauna, any waterfall, cave, grotto, avenue of trees, old tree or old building, and any other object of aesthetic, archaeological or scientific value or interest.

336. A Commission established under the Act, among its other powers, may acquire monuments if it has sufficient funds. These funds consist of such grants, donations, fees and subscriptions as may be paid to it. The Commission may also make byelaws and take certain steps for the preservation of national monuments. A number of places and objects have been declared national monuments, but the Act can scarcely have been intended and is not suitable for the purposes under discussion.

337. Your Commissioners are of opinion that the whole question of setting aside areas as parks, open spaces, recreational grounds, also resorts for the enjoyment of the nature lover and the recuperation of those requiring a change of scene, the protection of wild life, the stocking of streams and water with fish and thereafter the care of them, should be carefully considered with a view to making suitable provision on that behalf under specific legislative authority. This is a question which might suitably be referred to the Board contemplated in the last section of this Report.

338. It is thought the importance of the fauna as a national asset is not sufficiently realised. Evidence was given as to destruction of 12 elephants in the Nata Native Reserve during the preceding eighteen months, five under licence and seven in pits dug by bushmen. Want of adequate supervision was complained of. It was also represented that much damage is done by shooting on Crown land and that the opening date of the shooting season is too early for certain classes of game, especially pheasants. 57

XIX. MISCELLANEOUS.

339. This section of the Report is devoted to a number of matters which either do not appropriately fall within the various headings already adopted or belong partly to more than one of them.

340. Organisation and Control in Native Reserves. Some mention has been made of the manner in which deterioration has arisen and still persists in the land occupied by Natives both in the Reserves and in the European area. Taking a general view of the situation, deterioration may be attributed mainly to want of appreciation on the part of the inhabitants of the inevitable results of the changed economic conditions resulting from the European occupation of the country, and to the general want of control following on the breakdown of the tribal system. (It could not well be otherwise in a community holding in common such natural resources as land for grazing and tillage, and timber for fuel, house building, etc.)

341. For the regeneration of the Reserves there are two essentials organisation and control: organisation to ensure the best use being made of the natural resources; and

control to prevent abuses by the individual. An important step has been taken towards improved organisation through centralisation, but it is clear that this in itself will not supply an answer to the many problems awaiting solution. For example, the maintenance of the fertility of the new allotments in the arable sections on which their permanency depends has yet to be applied practically. Again, the whole question of the rehabilitation of the woodlands and the provision of timber for firewood and hutbuilding has to be worked out. Further, the utilisation of the grazing areas to the best advantage and in a manner to avoid deterioration is a matter of great importance in most Reserves. The maintenance of field works, such as contour ridges and dams, is yet another. There also remain the questions of the disposal of surplus stock and the marketing of agricultural produce, the former of which has a direct bearing on the destruction of the grazing areas.

342. Centralisation, then, requires to be followed up by further organisation and control in order to establish a working system which can finally be taken over by the people themselves through their Native Councils. This is essentially a matter for the local administration, as it demands unremitting attention if not actual residence in the Reserves. The work obviously cannot be carried out, at the beginning, at any rate, by the Native demonstrators, as it postulates executive authority of a nature which cannot easily be delegated.

343. The whole question of the organisation and control of the communal resources in the Reserves has been discussed with a number of responsible officers of the Department of Native Affairs. They are in complete agreement as to the necessity of such organisation and control, and the general view is that it is a matter for the local administration.

344. Where improved conditions have been brought about in the Reserves by the expenditure of much money and effort, it is essential that any retrogression should be guarded against. With a view to this end, it is recommended that special officers, who might be called Control Officers, should be appointed. For administrative purposes they would be under the Native Commissioner, but in technical matters would be guided by the officers of the particular department concerned. The area to be assigned to a Control Officer would depend on the number of matters needing his attention.

345. It has even been suggested that these Control Officers should belong to the administrative side of the Native Department itself. Your Commissioners are not in a position to say to what extent this is practicable. As at present recruited, there might be difficulty in finding officers with the necessary inclination and aptitude for this kind of work, but if men with these qualities were available, they could, on attaining the necessary seniority, be seconded to these posts where they would gain an experience and training which would stand them in good stead during the later years of their service.

346. It would appear that Native Commissioners and their staffs are so tied to their offices by a multitude of clerical and other duties for their own and other Government Departments that they are frequently unable to maintain as close a contact with the affairs of their districts as is desirable; hence it is thought that the Control Officers

recommended would be a useful link between the Native Commissioners and the activities in connection with the various improvement schemes within their jurisdiction.

347. It is recommended that specific powers be given by legislation to Native Commissioners and Control Officers to give instructions for the carrying out of measures or the refraining from acts in the interests of conservation, and that penalties be provided for failure to comply with such instructions. It is not thought that the provisions of section 51 of the "Native Affairs Act, 1927," on the subject of lawful or reasonable orders, requests or directions would be entirely satisfactory.

348. It may not be out of place to mention here that in order to obtain the cooperation of the Native in putting into force any measures for their betterment, the first requisite is to convince them of the necessity and reasonableness of such measures, otherwise they will be prone to look upon them as only the foolish notions of the white man.

349. Slaughter of Valuable Breeding Stock. At Bulawayo and Gwelo several witnesses, all of whom are in a position to speak with authority on the subject, stated that much good breeding stock is at present being purchased at the sales for slaughter purposes. This is a situation which frequently arises in other countries when the value of fat stock rises through scarcity to a relatively higher level than that of "stores," leading to the slaughter of certain classes of stock which would otherwise not be sacrificed. Heifers are usually the chief victims as they are generally in better condition than oxen. The adjustment takes place when the pendulum swings in the other direction. There is, however, much in the contention made by witnesses that the Colony cannot at present afford to lose good breeding stock and that efforts should be made to preserve it.

350. It was pointed out by one witness that the trouble was largely due to the fact that the better class female stock was usually presented at the sales in units too small to attract ranchers, who are always potential buyers of good cattle for breeding. In other countries this difficulty would be overcome by purchases by dealers buying for the store market. In their absence, the type of animal would, if exposed in small lots, naturally go to the butcher. A trial might be given to organised purchasing of small lots and reselling to ranchers and farmers for breeding purposes in order to test whether an effective demand does exist for the class of stock referred to.

351. Reversible Ploughs. Contour ridges give rise to some difficulties in cultivation. Few lands have an equal degree of slope throughout their length and thus few contour ridges are parallel to each other in the general sense of the term. In ploughing within contour banks there are, therefore, a considerable number of short lengths to be finished off a very inconvenient matter for large teams and multiple furrow ploughs. For this class of work the reversible plough is the most suitable implement. This has already been recognised and there is a considerable number of this type of plough in use in the Colony. It is stated that a further stimulus would be given through a reduction in cost, and the suggestion has been put forward that they should be popularised by purchase in bulk.

352. The general adoption of a new type of implement, more especially and expensive one such as a plough, must necessarily be a gradual process, as the substitution would, in the case of the individual, be postponed until replacement became necessary, but the question is one deserving of every consideration.

353. It has also been stated that an improvement in the design of the reversible plough is necessary for certain types of soil. We are unable to say how far the latest types meet the general requirements of farmers, but are thoroughly in sympathy with those who desire to see the implements of cultivation adjusted to the changed conditions brought about by the contour ridging system.

354. Compost. Reference has already been made to the loss of the fertility of the soil through erosion and other abuses and the vain efforts to restore it by the application of artificial fertilisers. The great value of farmyard manure in maintaining productivity is unquestioned, but as a general rule the supply is inadequate. An excellent substitute is found in compost. It is not proposed to go into details as to the methods of making compost. These are fully described by Sir Albert Howard, exponent of modern compost methods in his book "The Waste Products of Agriculture." An excellent bulletin by the local Department of Agriculture describes how the process can be adapted to Rhodesian conditions. The important point is that all waste vegetable matter such as grass, leaves, weeds, etc., may be used in its composition. Howard estimates the value of good compost at double or more than that of farmyard manure. Captain J. M. Moubay, of Chipoli, Shamva, an enthusiast as to the value of compost, estimates the cost of the finished article at is. 6d. per ton. In his evidence he said :

"I make the following considered statement: If a small fraction of the grass that is burned annually was turned into compost and added to the land, the agricultural output of Rhodesia could easily be doubled without breaking up any more land."

355. Shifting cultivation among natives could be avoided if they would use compost. It seems to offer the one ready means of maintaining soil fertility on restricted arable land under the centralisation scheme.

356. Stock Paths. Stock paths are a universal and serious cause of soil erosion throughout the Colony as they are in many parts of Africa. The evil is seen at its worst where cattle congregate at watering places or at dipping tanks, but paths extend for miles outwards where long distances have to be travelled to these centres. It is difficult in the circumstances to suggest a complete remedy, but an increase in both watering places and dipping tanks would obviously be beneficial, as would dipping at less frequent intervals. Lighter stocking would also act in the same direction, although not to the same extent.

357. It has been suggested that, in the case of Native cattle, to save undue concentration, the numbers to be dipped in one day should be restricted and the operations at the same tank spread over a longer period, but this would increase the work of the Dip Supervisors correspondingly and it is doubtful if the advantages claimed would not be altogether set off by the increased number of days in which dipping took place. If dipping tanks were

on level ground much erosion would be avoided, but, unfortunately, they are often built on highly erodible sites in order to be near water.

358. Attention has been called to the scarcity of dipping tanks on Crown lands. The complaint comes from Matabeleland where the Crown lands in the European area are occupied to a considerable extent by Natives. It was suggested that, as the Department of Lands is responsible for such land and as dipping tanks are actually selfsupporting, that Department should take the matter up. We concur in this view.

359. Speaking generally, it will be no easy matter to put an end to the soil erosion caused by stock paths, especially in Native areas, but this does not mean that nothing can be done. Nature rapidly reasserts herself, in the wetter parts of the Colony at least, and a rest from traffic works wonders. A temporary diversion by blocking up paths with brushwood, coupled with a little assistance in the way of barriers across the old tracks, would help considerably. The matter requires attention in most Reserves and in some parts of the European area.

360. Small Stock in the Reserves and Other Areas. Small stock in the Reserves and areas occupied by Natives consist of sheep and goats. While the former are for the most part as innocuous as cattle if kept within reasonable numbers, the latter are well known for their destructive propensities both to grass and other herbage. The creation of desert conditions in many areas throughout the world has been attributed partly to their agency. So far as pastures are concerned, sheep and cattle are purely surface feeders, but the goat is not content with this he not only prevents tree growth by consuming all young shoots, but he must needs eat below the crown and destroy the plant itself. It will thus be realised that goats account for far more than the usually accepted grazing ratio compared with cattle, viz., 1 : 5. In many Native areas there are obviously too many goats. They have already done and are still doing untold damage to the land, and it would be well if their numbers were reduced. We consider that a limitation of the number of goats held by the individual or family might well be imposed and that sheep as an alternative should be encouraged.

361. Indeed there are some overstocked areas where goats might be abolished, as in the United States of America, where large sums of money were spent by the Government in buying up all the goats in certain Indian Reservations in order that they might be destroyed and their replacement forbidden.

362. It has been suggested that goats may be of value in certain cases, especially where scrub growth threatens the grazing area. This is just possible. Due allowance must always be made in exceptional cases.

363. Donkeys. Large numbers of donkeys, often ownerless and unused, are allowed to roam about the Reserves. They are an additional strain on the grazing resources of the country in times of scarcity, not only consuming all forms of vegetation, but also by pawing up and eating grass roots. Their numbers should be reduced to the actual requirements of the community.

364. Damage caused by Wagon Roads and Tracks. There is ample evidence to show the vast amount of damage done by roads and wagon tracks made for some temporary purposes, and by roads abandoned in favour of some new highways or on account of deviations. The Government and other bodies responsible should, on abandoning a road, take steps, such as placing barriers of brushwood, earth or rocks to control and divert the water in a safe manner. Simple measures of this kind assist nature in arresting erosion by a vegetal covering. The damage caused by vehicles transporting wood to mines and elsewhere was the subject of much complaint. Many parts of the countryside are scarred by unsightly dongas which had their origin in these roads. The common law requires the holder of a servitude over another's property to exercise that right in a reasonable manner. It is wholly unreasonable to make a multitude of paths, often up and down hill, when a few, probably more on the contour, would suffice. The practice of transporting wood in the rainy season, when the soil is soft from rains, should be stopped. When a few trips over the soft ground have made the track difficult or impassable, it is abandoned for another, and in this way a large area of land may be greatly damaged. One farmer complained bitterly of the loss he was suffering through the operations of a Native who had a contract to cut and convey wood to a mine.

365. The asphaltstripped main roads have been an undoubted boon to the country, but as they may not be used by anything but rubbertyred vehicles, the unmade parallel tracks used chiefly by animaldrawn vehicles are often very badly eroded. In the wet season they are almost, if not altogether, impassable in places, and draught animals are at times subjected to considerable cruelty in negotiating them.

366. Drainage of Roads and Railways. Road makers and railway builders are chiefly concerned with questions of drainage and the disposal of accumulated water in so far as concerns the works under their control, and are inclined to neglect steps to prevent damage to land outside the road or railway track. There are many instances where water has been allowed to accumulate over an excessive distance on the upper side of such works and then led in a large volume to the lower side where, in the absence of any natural waterway or precautions to spread it over the veld, it brings about extensive erosion. Having heard the Chief Road Engineer and obtained the views of the Railway authorities in the matter, we are satisfied that they are alive to the situation and that all reasonable steps will be taken to avoid the evil complained of, by ensuring that drains are constructed of adequate width and correctly graded to obviate scour. It is suggested that the attention of Road Councils be drawn to the necessity of providing against this evil and that simple instructions as to how to avoid it be conveyed to them.

367. Sledges. There is an almost incredible amount of damage done by the destruction of the vegetation and the erosion induced by the tracks caused by native sledges, which are generally of a triangular shape consisting of two converging branches of a tree with or without a superstructure to carry the load. This wedgeshaped sledge is admirably adapted to breaking up the soil. Formerly, when there was little or no production of grain except for home use, baskets sufficed for all requirements, but now it is conveyed great distances by sledge for sale. The sledge is becoming the popular vehicle for all transport, such as the fetching of water to the kraal. An official of the Department of Native Affairs

exhibited a diagram showing that no less than 45 sleigh paths occurred in the course of a nine mile stretch of road. He stated that some of them had eroded and become substantial dongas, and also emphasized the desirability of prescribing the number of tracks to be used and the necessity of seeing the restriction enforced. No effort should be spared to introduce the use of wheeled vehicles at a price within the Native's reach.

368. In reply to a suggestion that kraals might be provided with carts for communal use, it was stated that the care of such vehicles falling to nobody in particular they would be entirely neglected. It is thought that much might be done to secure the employment of donkeys for pack purposes, particularly by the introduction of carriers.

369. Dipping of Cattle. There was some evidence to the effect that the constant dipping in arsenical solutions led to the deterioration of cattle. This view was strongly expressed by one old settler who, however, said: "Dipping is a good thing, but it must not be done with arsenic." Your Commissioners are not in a position to say whether or not dipping in arsenical compounds has any deleterious effects, but as it appears that no success has hitherto been obtained in securing an effective substitute and dipping is a necessity, there is at present no alternative. A suggestion by the same witness that calves should not be dipped until nine months old in order that they may become immune to redwater and gall sickness is deserving of consideration.

370. Agriculture in Matabeleland. If your Commission's recommendation is accepted, steps would be taken to provide one or more Pasture Research Stations to deal with the conditions in Matabeleland, but the agricultural possibilities there must not be neglected. There may be some substance in one leading farmer's statement that 'there has grown up in Matabeleland a kind of inferiority complex in regard to agriculture.' There seems no reason why, with effective methods of soil and water conservation, much might not be done to put agriculture on a successful basis. One progressive lady mentioned that in the previous exceptionally bad season she was the only person to reap a single bag of maize in that area as the result of protecting her land.

371. Your Commissioners recommend that an agricultural experiment station be instituted in some place in Matabeleland typical of a large area of the country. The present Matopos Station is not considered typical with a view to demonstrating methods of agriculture suitable to the less humid parts of the country. An agriculturist attached to this station should be available to advise farmers and visit their farms.

372. Rights of Natives to Land. It has been observed that there is a tendency for Natives earning good wages in various forms of employment to invest their savings in stock which in some cases tends to increase the evil of overstocking. It is further stated that Natives who have become detribalised often acquire land, although not intending to occupy it personally or in any case not for many years. Your Commissioners are of opinion that these tendencies should be discouraged in the case of Natives who have become absorbed in industrial and other occupations.

373. The Southern Rhodesia Native Reserves Commission, 1915, interpreted section 81 of the Order in Council, 1898, providing for the setting aside "from time to time" of sufficient land for the requirements of Natives, as visualising a section of the Native community ceasing to live under old tribal conditions, and that the words "from time to time" implied that a final settlement could only be attained by gradual adjustments to suit the changing needs of the two elements of the population. The Commission proceeds to say:-

"But certain students of Native affairs in Rhodesia appear to have regarded these words as meaning that, as the Native population increases, every individual is to retain an indefeasible right to land sufficient for his occupation and suitable for his agricultural and pastoral requirements according to the primitive methods of Native life. If this interpretation be allowed it is evident granting that European rule will eliminate tribal wars and check human and animal diseases that there can be no limit to the extension of the Native Reserves; and if the argument is pursued to its logical conclusion the whole of Southern Rhodesia will, in course of time, be required for this purpose.

This extreme view is only mentioned to show the absurdity which it might involve. The Commission is of opinion that it cannot be assumed that every unborn Native is to enjoy an indefeasible right to live on the soil under tribal conditions and by the primitive and wasteful methods of cultivation practised by his forefathers."

The foregoing views support the opinion already expressed by your Commissioners that the solution of the problem of meeting the requirements of the Natives does not simply lie in giving them more and more land.

374. Conservation Experiment Station. A technical officer employed in the Division of Irrigation who has had wide experience of conservation work in this country and who recently visited America to study the subject there, strongly recommends the institution of an experiment station near Salisbury for the study of the many questions affecting soil and water conservation and to show farmers the proper methods of handling the soil and the advantages of conservation works. He estimated that such a station could be equipped for £600.

75. Education. It is recommended that simple lessons designed to create an interest in the beauties of nature and in the preservation of the natural resources of the country be given to European school children.

376. It was pointed out by missionaries and others that the long school holiday falling in December and January a most important period for farming operations was a great handicap in the agricultural training of the Natives.

377. Destruction of Contour Ridges, etc., by Natives. A number of witnesses complained of the damage done by Natives making breaches in contour ridges in the pursuit of rats, by felling trees when collecting caterpillars or honey, and by cutting footholds in

fruitbearing trees. It is thought that the offenders could be dealt with under existing laws; if not, then special legislation to meet the situation is desirable.

378. Aerial Surveys. From information put at the disposal of the Commission by the Aircraft Operating Company of Africa (Pty.), Ltd., and obtained elsewhere, the Commission is satisfied that aerial surveys provide a speedy and efficient method of ascertaining the leading features of the earth's surface, showing the nature and extent of erosion and determining the relative areas of arable and nonarable land. It is understood that the question of carrying out such surveys is receiving the attention of the Government.

379. Water Power. A few witnesses called attention to the importance of encouraging the use and development of the water power resources of the Colony. The chief obstacle is the great seasonal fluctuations of the volume of the rivers in places where there would be a demand for this form of power, and the remote situation of rivers with a more sustained flow. Notwithstanding this, there may be many places where this cheap form of power might be used. An excellent article by Mr. C. L. Robertson, Director of Irrigation, dealing exhaustively with the subject of the water power resources of Southern Rhodesia was published in the Agricultural Journal of February, 1922.

380. Income Tax. Strong representations were made against the ruling of the Income Tax authorities that the cost of such works as storm drains, contour ridges and other protective measures should be regarded as capital expenditure. It is contended by the Rhodesia Agricultural Union that these works, being necessary to maintain the land in a proper condition and prevent deterioration, are in the same class as repairs to and upkeep of buildings. The contention seems reasonable, and if the letter of the law is against the farmers then it is recommended that it be altered.

381. Publications. It is feared that excellent articles in the Agricultural Journal, which are intended for and would be helpful to farmers and others connected directly or indirectly with agriculture, do not come to the notice of many of them as they do not subscribe to this publication. It may be said that they should do so, but your Commissioners suggest that better results might be achieved if it could be arranged to include a Farmers' Supplement in the weekly editions of the leading newspapers. The Bantu Mirror, a weekly paper circulating among Natives, might be used in a similar manner.

382. Malaria and Bilharzia. Some witnesses advanced the view that the conservation of water would increase the incidence of malaria fever and bilharzia. The Chief Health Officer and Director of Medical Services, however, assured the Commission that provided ordinary precautions are taken there is no serious danger.

383. New Settlers. One witness suggested that the only person who should be allowed to farm is the man who loves the soil and wishes to make a home on the land; another stated that settlers should not be permitted to take up land unless they had a knowledge of modern methods of conservation and farming. While it is true that the land suffers from the operations of those who do not love it and from inexperienced settlers, it is obviously

impossible to impose the restrictions suggested. Reliance must be placed on propaganda, education and the taking of general measures directed against waste of the country's resources by whomsoever caused.

384. Low Percentage of Calves. Evidence was given to show that whereas in many overseas countries the calf drop on all the better managed farms and ranches varied from 75 to 85 per cent. and sometimes reached as high as 90 per cent, or over, in Southern Rhodesia the average for the years 1933, 1934, 1935 and 1936 were 47, 46, 48 and 51 per cent, respectively. This is a serious state of affairs. A valuable article by the Senior Animal Husbandry Officer in charge of the Government Experimental Station, Matopos, in the Bulawayo Chronicle of the 31st August, 1938, deals with the question and indicates the causes of the low percentage and means of its prevention.

385. Use of Roadways as Weirs. The suggestion was made that roadways and low level bridges across streams and rivers might be constructed to serve as weirs for conserving water. There are technical objections to the proposal and the number of places where water so stored could be directly applied to any useful purpose is limited.

XX. NATURAL RESOURCES BOARD.

386. In the preceding chapters attention is called to the various directions in which the natural resources of the country are being wasted or deteriorated and in some instances definite recommendations are made as to how they may be conserved, improved and to some extent restored. The Commission, however, is not a scientific body which can prescribe specifics to be applied to all of the many problems which arose in the course of its inquiries. To some of these problems it can only direct attention and point out the necessity of taking steps to solve them.

387. Your Commissioners feel that the carrying out of such of these recommendations as the Government may adopt and the consideration of the problems to which they have directed attention are of such vital importance to the Colony and concern so many different interests that there may be a danger of these questions being overlooked or obscured, either through their not being the special concern of any one in particular or being left to the individual consideration and decision of a Minister or Departmental Head, without their general implications being sufficiently realised. In order to avoid this danger and to maintain a permanent live interest in conservation matters, your Commissioners recommend the setting up of a standing body to deal with all questions touching the natural resources of the Colony. This body might be called the Natural Resources Board.

388. It is recommended that this Board be appointed by the Governor in Council, and be composed of a Chairman selected either from the public or a Government Department it might be as well if he were not otherwise directly concerned with conservation matters. The other members, not less than three in number, would be chosen either on account of their special knowledge of problems likely to come before the Board or because of their special relationship to any section of the community that might be especially affected by

such problems. For example, the Director of Irrigation, the Conservator of Forests, and someone experienced in agricultural matters, suggest themselves as members on account of the nature of their qualifications, and an officer of the Native Affairs Department (if not already a member of the Board) on account of his special knowledge where questions affecting Natives arise.

389. The Board, so composed, with a permanent Secretary, would exercise general supervision over the natural resources of the Colony, and by propaganda and other means endeavour to promote a public interest in their conservation and improvement.

390. As already indicated, there are several provisions in the "Water Act, 1927," as amended in 1938, relating to conservation, which, although good in principle, might be of difficult and uncertain application. For example, it is provided by section 108 (1) of the Act that on a report from the Water Court the Minister may construct and maintain such works as he may deem desirable for the protection of a source of a public stream, and the Court may be required by the Governor to apportion the costs of the works between the persons benefiting therefrom. Now, the only permanent member of the Water Court is the Judge, and the full Court is only constituted to deal with matters which have arisen for disposal at the direct instance of the parties concerned. The composition of the Court varies each time it is constituted. It is not stated at whose instance the Court would make a report provided for in section 108 (1). It would hardly do so of its own initiative and it might happen that it was not well fitted for the task.

391. There is the same object to section 108 (3), which provides for the Minister on a similar report ordering an owner or an occupier of land to take measures for protecting the source of a public stream.

392. Again, section 29, 30 and 31 of the "Water Amendment Act, 1938," contain certain provisions intended to promote soil conservation; for example, a Soil Conservation Board appointed by the Minister may recommend the preventive measures which it thinks desirable that any person should take. If he refuses to take them, then the Board reports the matter to the Minister, who may refer it to a Water Court for inquiry and decision.

393. The above provisions would be difficult to apply and it may well be contended that, for political and other reasons, these matters of national importance should not be left to the discretion of the Minister holding office for the time being. Your Commissioners are of opinion that the proposed Natural Resources Board should have power to investigate and, failing voluntary compliance with their recommendations, make orders in these and other matters directed to conservation, and that an appeal should lie from these orders to a suitable tribunal. The simple procedure followed by the Water Court suggests it as a Court of Appeal, provided that the Assessors are specially selected. There is a precedent in the Act for such selection in certain cases.

394. It is recommended that inspecting officers under the control of the Board be appointed to encourage conservation, keep the Board in touch with matters affecting

natural resources throughout the Colony and he entrusted with such other powers and duties as may be deemed expedient. They might be called Conservation Officers.

395. The cooperation of the whole community should be sought in furthering the work of the Board, and to this end provision should be made for the appointment of local committees in respect of defined areas to cooperate with the Conservation Officers, which might be styled Conservation Committees.

396. It is unnecessary to try to set out in detail the many powers and duties that should be assigned to the Board and officers concerned with conservation matters. In the course of this Report certain matters have been mentioned as properly coming within its sphere. To state the position broadly, your Commissioners envisage a Board, constituted by Act of Parliament, which would in essence be the Public Trustee for the natural resources of the country and have the necessary powers for performing its functions as such trustee. Its primary duties would be to safeguard these resources. For this purpose certain executive powers would be necessary. It would advise the Government on legislation and other questions affecting them, and investigate and report upon State and other conservation projects, and no such projects involving any considerable expenditure of public funds should be undertaken without a favourable report by the Board.

397. The Board, through its Secretary or Chairman, should have direct access to the Minister under whom it is placed for administrative purposes. It should be required to furnish an annual report for submission to Parliament, setting out its activities, the recommendations made by it to the Government and stating in how far they were adopted.

398. It is thought that the members of the Board would largely regard their work as a labour of love in the public interest and would not require any remuneration beyond reasonable expenses for travelling and subsistence while engaged on the business of the Board.

399. If the Government should see fit to adopt the Commission's recommendation as to the appointment of a Board, the Chairman would be pleased to assist in drafting the legislation necessary for its constitution.

400. In conclusion, your Commissioners had not gone far in their enquiries before it was realised that if effective measures were taken to combat the various evils mentioned, a considerable expenditure would be involved. Notwithstanding this, we have felt it was our duty to recommend measures which we consider best suited to serve the national interest without being unduly influenced by financial considerations. At the same time, guided by the tragic experiences of other countries which have failed or neglected to protect their national assets and remembering that evils such as soil erosion proceed with evergathering momentum, it will be readily realised that in these matters there is a danger of spending too little rather than too much.

R. McILWAINE, Chairman.
O. A. DAVENPORT,
A. C. JENNINGS,
S. MILLIGAN,
Members of Commission.
L. B. A. CODD, Secretary.
Salisbury, 28th April, 1939.

Appendix 1.

RURAL DEVELOPMENT WORK FOR NATIVES.

EARLY HISTORY AND GROWTH.

The inception of a scheme for rural development of the Natives in Southern Rhodesia goes back to the year 1910¹¹, when the Southern Rhodesia Native Affairs Committee recommended:-

(1) The establishment by Government of central institutes in Reserves, where teaching may be given by expert instructors, not only in regard to the proper method of tillage, but also to the treatment and rotation of crops and all other branches of agriculture. Instruction would also be given in the management and breeding of stock.

(2) The immediate establishment by Government of a central training institute for Native teachers.

The first step, however, was taken in 1920, when the Southern Rhodesia Legislative Council authorised the establishment of central training institutes for Native industrial and agricultural teachers.

In June, 1920, Domboshawa School was established in a corner of the Chindamora Reserve and two instructors were appointed, one with the combined duties of principal, farm manager and agricultural instructor, and the other instructed in woodwork and building. The entire educational plant had to be erected by the pupils themselves.

There are now just under 300 pupils enrolled at this school and a waiting list of several hundred applicants for admission.

In 1921, the development of water supplies was started on Native Reserves in Matabeleland. During the 18year period to date a total of 390 boreholes were sunk on Reserves, 281 pumps were installed, 42 windmills erected, 23 wells were sunk, 52 storage tanks were erected, 72 watering troughs were installed, and 83 storage dams were constructed, under the Director of Irrigation.

In 1924, Tjolotjo School was established on the Gwaai Reserve in Matabeleland.

In November, 1924, the first group of pupils was enrolled for training as Agricultural Demonstrators on Native Reserves.

A total of 127 Demonstrators have been trained to date.

In 1926, an Agriculturist for Instruction of Natives was appointed whose duties were to better organise agricultural instruction in Mission schools throughout the country and to have charge of agricultural development work on Native Reserves. His staff now consists of eight Europeans.

In 1927 a fiveyear course in practical agriculture and allied subjects was put in the Domboshawa School curriculum, and organised courses in agriculture were started at several of the more important Mission schools throughout the country.

In July, 1927, the first group of Government trained Agricultural Demonstrators assumed duty on Native Reserves to work exclusively among Native farmers. This group has been increased year by year. The total number now employed by Government is ninetyeight.

In 1928, a Department of Native Education was established as separate from the European Department of Education. Its establishment marked the beginning of an unparalleled development of rural schools for Natives.

In 1929, the first survey for centralisation of arable and grazing lands was made by the Agriculturist on Selukwe Reserve. This marked the beginning of a movement which is, without question, the most important phase of rural development work for Natives. Centralisation is the keystone on which community development, permanency of agriculture and soil conservation are centred. The total area centralised to the end of 1938 was approximately 2,407,500 acres. There are 28 more Reserves where centralisation has been asked for, which total 5,734,500 acres.

In 1930 a start was made on the development of irrigation projects in the area of low rainfall in the Sabi Valley. This movement has since eliminated the annual serious food shortages and periodical famines throughout that "famine belt" area. The first water furrow was opened in 1931. Five different irrigation furrows have been completed to date, which command approximately 5,000 acres of irrigable land. A sixth project is now under construction.

In 1932 the first Community Demonstrator was located on the Selukwe Reserve in order to fill a demand arising out of the centralisation of arable and grazing lands and the location of model rural villages on boundary lines between. Thus the policy of locating Community Demonstrators on all centralised Reserves was originated.

There are now a total of 12 Community Demonstrators located and these have laid out a total of 871 "model rural villages," assisted or advised in the erection of 17,474 improved type of houses, 47 school houses and 16,058 grain huts, improved 62 village water

supplies, established 153 community tree plantations, constructed graded roads through 70 villages, and advised in the digging of 3,176 compost pits.

In 1933, topographical and soil survey work was started on Native Reserves for the purpose of mapping and classifying soil types and ascertaining agricultural and grazing potentialities. Two Land Inspectors were appointed for this purpose. To the end of 1938, a total of 6,831,959 acres of Reserve soils have been mapped and classified.

In 1933 the Assistant Agriculturist was appointed, thus making possible closer supervision of demonstration work throughout the country and permitting the Agriculturist to give more attention to important development work.

In 1934 cotton growing experiments were started on Native Reserves in an effort to popularise this important cash crop among the natives.

In 1935 the first Experimental Farm for Natives was established for the purpose of improving various Native crops and producing improved seed for free distribution to Natives.

In 1936, a scheme for soil conservation was adopted for Native Reserves, A Soil Conservation Officer assumed duty and the first group of Erosion Control Demonstrators was appointed.

At present there are gangs at work on 10 different Reserves and to the end of 1938 a total of 1,140,729 yards of contour ridges had been constructed, 34,004 yards of storm drains dug, and 16,087 acres of arable lands protected, at an average cost of 3s. 7d. per acre and £2 13s. 4d. per thousand yards of contour ridges. In addition to the above work under the Soil Conservation Officer, our Agricultural Demonstrators throughout the country have done a large amount of erosion work on Reserves.

In 1937 an Experimental Farm for Natives was established in an arid part of Matabeleland for the purpose of developing and improving droughtresistant, quickgrowing varieties of crops for free seed distribution to Natives in the more arid parts of the country.

In 1938 a Land Management Officer and two additional Land Inspectors were appointed to meet the increased demands from Natives for centralisation surveys in Reserves.

An Irrigation Supervisor and an additional Land Inspector have been authorised for appointment in 1939.

Appendix II.

MEANS OF IMPROVING SOIL AND WATER CONSERVATION.

The following are the methods recommended for improving soil and water conservation, and are arranged in the order of their relative importance.

A. In Veld.

- (a) The maintenance of a good natural cover by the restriction of timber cutting, controlled grazing and the prevention of veld fires.
- (b) The limitation of stock in order to prevent overgrazing of the area.
- (c) Improvement of the natural cover by the planting of pasture grasses or trees in plantations.
- (d) The proper alignment and drainage of roads and the elimination, as far as possible, of bypaths and cattle tracks. The control of grazing involves the installation of fencing to provide paddocks of suitable size and the development of water supplies in the paddocks, either by boreholes or small storage dams.

The prevention of veld fires involves the construction of suitable fire guards and the maintenance of fire rangers during the latter end of the dry season.

B. In Arable Lands.

- (a) The construction of storm drains of adequate size about all cultivated lands and the provision of natural outlet channels at frequent intervals.
- (b) The construction of contour ridges of adequate height and base width on all lands which have a slope of more than 1 in 100.
- (c) The working of all land on the contour irrespective of whether it has been contour ridged or not.
- (d) In the case of lands on a gentle slope which are not contour ridged, the land should be subdivided into blocks of small extent and belts of natural vegetation left between each block or alternatively strip cropping may be adopted.
- (e) The proper working of the land in order to maintain and improve the soil structure.

In order to keep the size of storm drains to reasonable dimensions and thus limit their cost, it is essential that the water from them should be discharged into natural drainage channels as soon as possible, and this involves utilising all natural depressions which should remain unploughed and in their virgin condition.

As a general rule it may be said that a natural outlet channel should be provided for the disposal of surplus water from each 100 acres of arable land, i.e. no single block of arable land should be more than 100 acres in extent.

The proper working of the land involves deep ploughing, proper crop rotation, and the increase of the humus content in the soil by compost or green manuring.

C. Gully Control.

- (a) The grading off the banks to a stable slope of about 1 in 3 and the planting of the banks with grasses or shrubs.
- (b) The construction of cheek dams of wire and stone bolsters, masonry, concrete or earth and grass turfs.
- (c) The construction of drops paved with masonry or concrete.
- (d) The construction of fences to keep out cattle and prevent them from damaging the banks.

D. Pastoral Lands.

In natural or improved pastures in areas of low rainfall the grazing will be improved by the construction of contour furrows or contour ridges to increase the amount of water absorbed in the soil.

The cover will be improved by the gradual introduction of better grasses and by controlled grazing, mowing and paddocking.

In certain cases also conditions may permit of storm water being delivered and utilised for the irrigation of the area by a system of drains and ridges.

E. General Conservation.

A general conservation policy must embody the construction of a series of small storage dams on each river system, and the providing of an adequate number of dip tanks to prevent unnecessary lengthy movement of stock.

All roads should be properly aligned with properly graded road drains and culverts of proper design.

The number of roads should be restricted to as few as possible and in particular some control should be exercised over the roads made by wood cutters.

A policy for the more general use of electric power or fuels other than wood or charcoal should be instituted in order to limit the amount of timber cutting and the damage caused by the tracks made for the purpose of transporting the timber, and in particular, the provision of the law prohibiting the cutting of timber on stream banks should be enforced,

EXPENDITURE ON SOIL CONSERVATION FOR EUROPEAN AREAS.								Appendix III.
Service.	1933/34.	1934/35.	1935/36.	1936/37.	1937/38.	1938/39.	Total.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	
Local Technical Assistants	—	—	193 4 3	497 19 2	1,049 8 6	1,792 6 10	3,532 18 9	
Demonstrations	—	—	13 4 11	352 9 11	557 11 6	9 10 0	932 16 4	
Mileage allowances (Members of Council)	—	—	13 0 8	10 0 0	12 10 0	17 0 0	52 10 8	
Trials of Ditchers	—	—	—	—	179 2 5	6 6 1	185 8 6	
Ditchers for Farmers' Associations	—	—	—	—	106 6 7	112 0 0	218 6 7	
Propaganda	—	—	34 10 8	4 19 10	38 14 10	57 15 5	136 0 9	
Experiments: Salisbury	223 12 1	0 18 9	44 2 5	0 14 0	11 0 7	0 10 0	280 17 10	
Experiments: Bulawayo	—	—	374 8 10	27 9 8	20 10 10	5 12 11	428 2 3	
Experiments: On vleis	—	—	—	—	12 0 1	—	12 0 1	
Sub-Committees	—	—	—	7 10 7	—	—	7 10 7	
Farmers' Tours	—	—	—	58 3 4	—	—	58 3 4	
	£223 12 1	£0 18 9	£672 11 9	£959 6 6	£1,987 5 4	£2,001 1 3	£5,844 15 8	
	Audited	Audited	Audited	Audited	Unaudited	Unaudited to 1/3/39 only		
IRRIGATION LOANS FOR SOIL CONSERVATION.								
Number: 17		Total amount: £1,338						
EXPENDITURE IN NATIVE RESERVES: SOIL AND WATER CONSERVATION, ETC.								
			1938/39.	1939/40				
				(Estimated).				
Soil Conservation			£3,034	£13,000				
Water Conservation			16,203	26,760				
Irrigation Schemes			3,021	6,700				
			£22,258	£46,460				

Appendix IV.

MEMORANDUM ON CONSERVATION OF NATURAL RESOURCES.

The two natural resources of fundamental importance to a community are those of soil and water, but the soil itself is the one of prime importance, as any wasting of this asset due to erosion inevitably results in a diminution of the available surface water supplies due to the silting up of the natural water conservation works the pool the more rapid and increased rate of run off of the flood water and the destruction of vleis with the consequent lessening of seepage flow to the stream beds.

The deterioration of catchment areas in the Colony has been proceeding at a progressively accelerated pace from the early days of white settlement, but it is only in recent years that there has been any general realisation of the fact that our available water supplies have seriously diminished and that steps must be taken to prevent it.

Any sound conservation policy must provide for the reclamation and conservation of these two prime natural resources with the minimum of expenditure, and can therefore be best implemented by the preservation of natural conditions to the greatest possible extent.

Although the mean annual rainfall in Southern Rhodesia is in the neighbourhood of 28 inches, a study of the rainfall records will show that

(a) Practically two thirds of this amount occurs during the three months December to February in the form of showers of heavy intensity, and that during the months of May to September the amount of rainfall is negligible.

The mean rainfall, based on 39 years records, which occurs during these various periods is as follows:—

July to September 0.36 inches
 October to November 4.22 inches
 December to February 18.16 inches
 March to April 5.00 inches
 May to June 0.47 inches
 28.21 inches

(b) That the rainfall is extremely erratic in its annual distribution and that there are successions of seasons of below normal rainfall followed by a succession of seasons of above normal rainfall.

There is a tendency for seasons of above and below normal rainfall to group themselves in alternating periods of approximately 12 years in length, as shown in the following schedule:—

	Period		
	Above Normal	Below Normal	
1890/91—1901/02	7	5	Records incomplete. Very few statistics available.
1902/03—1913/14	3	9	Dry period.
1914/15—1925/26	8	4	Wet period.
1926/27—1937/38	2	10	Dry period.
	—	—	
	20	28	
	—	—	

(e) That there are partial drought periods of varying length in excess of two weeks during each rainy season and that these partial droughts periods are more persistent and numerous in those portions of the Colony which have a normal annual rainfall of less than 25 inches.

The following schedule shows the average duration and number of drought periods which have occurred in the various portions of the Colony during the last fifteen rainy seasons:

Area	Average length drought period, days	Average number drought periods per season	Greatest number drought periods any one season	Lowest number drought periods any one season
Western Matabeleland	16	4	6	1
South-Eastern Mata.	17	4	7	1
Western Mashonaland	13	3	4	—
North-Eastern Mashon....	14	2	3	—
South-Eastern Mashon.....	15	3	5	1
Eastern Border	12	2	4	—

To ensure the sound agricultural development and settlement of the Colony these rainfall conditions necessitate:

(a) The construction of relatively large storage works to enable the flow in the rivers to be stabilised throughout the year and to provide a reserve of storage for the years of below normal rainfall.

(b) The improvement by all means practicable of the moistureholding capacity of the soil and the reclamation and the preservation of the catchment areas to prevent their absorptive capacity being reduced by erosion.

These requirements can best be met by the construction of contour ridges on both arable and pastoral land and the provision of water conservation works, both large and small, situated not only along stream and river courses but also below the outlets from contour ridges at all convenient points.

The preservation of the catchment areas to prevent their absorptive capacity being reduced by erosion could be ensured by the adoption of the following measures in any area to be completely protected:-

(a) The construction of adequate protection works in all arable lands unless these lands have been classified as not requiring protection either owing to their limited extent or the flatness of their slope.

(b) The noncultivation of certain areas to be specified, viz., in vleis, on steep hillsides, or within a limited distance of streams and drainage channels.

(c) The prevention of erosion in these noncultivated areas by limiting the amount of stock carried and the control of grazing by means of paddocking and the provision of adequate water supplies. In the case of steep hillsides the cutting of timber should be prohibited, and in the case of slopes already denuded the reafforestation of these areas should be effected.

(d) The practice of burning the veld should be prohibited in the whole area, and adequate fireguards constructed and maintained to prevent the risk of fires entering from outside the area.

(e) The reclamation of areas already badly eroded.

(f) The control of flood run off by the construction of storage works at all feasible sites in the natural draining channels below the outlets from the storm drains.

Although it would be desirable to introduce legislation compelling the adoption of the above measures for the protection of catchment areas, it is doubtful whether this would be practicable at the present stage unless the Government were prepared to finance the cost of protection works and to provide adequate staff to carry out the necessary surveys and investigations.

It would, however, be feasible to provide for compulsion being operative in any limited catchment area where a referendum shows that a majority of the landowners are in favour of compulsion.

In the first instance the areas concerned would probably be relatively small catchment areas in which a considerable amount of protective work has already been completed and where the owners wish to be made secure against the risk of damage from the unprotected areas.

The boundaries of the areas affected would, however, be extended from time to time as the benefits derived from completely protected catchment areas become apparent.

In order to make the scheme attractive to landowners, special subsidies might be granted in respect of protection works already constructed in areas where compulsion becomes operative.

In the Native Reserves every effort is now being made to speed up the construction of soil conservation works and to introduce a centralisation policy defining what areas are suitable for cultivation and the areas which are to be reserved for grazing and afforestation.

All measures of protection in these areas will, however, be nullified if the evil of overstocking, which at present is the most fruitful cause of erosion in the Reserves, is not overcome.

It is essential that there should be a limitation on the numbers of stock allowed to graze in each reserve and that the willing cooperation of the native should be obtained in accepting the principles of a sound conservation policy in these areas.

It is suggested that possibly such cooperation could best be secured through the Native Councils now being set up in many of the Reserves and by the appointment of Conservation Officers who will be responsible for carrying out the policy in a group of adjacent Reserves.

I attach a memorandum by Mr. Haviland, Irrigation Engineer (Matabeleland) containing his suggestion of points of particular importance in Matabeleland.

C. L. ROBERTSON,

Director of Irrigation.

Appendix V.

A CONSERVATION POLICY FOR MATABELAND.

Any sound conservation policy must provide for reclamation and preservation of the natural resources, soil and water, in such a manner as will permit of economical use to be made of them later. Further, it must be carried out with the minimum expenditure, and this can best be attained by the use of natural conditions to the greatest possible extent.

Rainfall conditions require to be studied to appreciate the difficulties entailed in the task and to enable the most suitable plans to be formulated. Generally speaking these conditions are anything but ideal; the incidence is erratic and during the last thirty-six years there has been a predominance of subnormal rainfalls. In Matabeleland there appears to be a tendency towards a grouping into alternate series of twelve seasons with a majority of above or below normal rainfall, and the 1938/39 season, under such grouping, is the first of a fresh series of twelve in which the majority should be above normal. If this is correct, it is essential that the greatest efforts be directed towards sound and effective conservation of soil and water during the next twelve years in order to be prepared for the following series of lean years.

In addition to the occurrence of many years of subnormal rainfall, Matabeleland suffers to a very marked extent each rainy season from short period droughts each of an average duration of 16 days. These drought periods occur approximately once in each month during every season of subnormal and slightly supernormal rains, and are liable to occur on at least two occasions during the seasons of heavy rainfall. The short period drought may produce very harmful results, particularly in so far as agricultural operations are concerned as if due to their occurrence there is insufficient soil moisture present at the critical stages of crop growth, the crop will be a failure. Grazing conditions may also be very adversely affected in a similar manner. Crop and pasturage deterioration and the general diminution in surface and underground water supplies cannot, however, as is popularly assumed to be the case, be directly attributed to short and erratic rainfalls and the true reason for the general drying up of streams and rivers is the very marked reduction in the amount of rainfall absorbed resultant on increasing agricultural, ranching, mining, industrial and other activities associated with our civilisation. The larger the areas which are cleared for these purposes, the greater will be the runoff and the less the absorption, and consequently as these activities increase so the water supplies of the country will diminish unless artificial means are adopted to improve them.

Adequate supplies of water are essential for successful stock breeding, not only for the watering of cattle, but also for use in cattle dips, and suitable supplies for these purposes can only be obtained from perennial streams, open water conservation works or from wells and boreholes tapping the deeper seated underground supplies. Both perennial streams and underground supplies are dependent on adequate absorption of the rainfall and unless the natural reservoirs from which these supplies are fed are replenished, they will eventually disappear. Absorption is therefore all important and any general policy of water conservation must aim at effecting an improvement in general absorption, in addition to the provision of open water conservation works.

During the rains, rivers and streams carry fine sand and silt in suspension and also convey a rolling load of coarser sand, pebbles and boulders. The deposition in small open

conservation works of the rolling load has generally no harmful effects and in some cases may be advantageous in reducing evaporation losses, but fine sand and silt produce nothing but deleterious results when deposited in such works, and consequently silt trapping is essential to successful water conservation.

It will be seen, therefore, that a sound water conservation policy must aim at increased absorption into the soil, the provision of open water conservation works and the trapping of silt.

These requirements can best be met by a combination of contour ridging on both arable and pasturage lands and the provision of open water conservation works, protected by suitable silt traps, and situated not only along stream and river courses but outside defined water courses as well.

Simple contour ridging results in greatly increased absorption and reduces the amount of silt carried off by storm water, but is not sufficient in itself to take care of the whole of the runoff and consequently must be modified by the adoption of other forms of construction.

On arable lands a straightforward system of ridging may generally be adopted in so far as the lands themselves are concerned, but all surplus water should be discharged into open conservation works located at the ends of the ridges or at other suitable points either in natural water courses or on grazing areas. The open conservation works should be increased in size and number with the ultimate aim of conserving all surplus water.

On pasture lands the general location of ridges should be such as to divert storm water from the main drainage depressions and convey it to the slopes situated on each side of these depressions. In order to conserve as much rainfall as possible open excavations should be constructed at intervals along the upper side of each ridge; these excavations should be increased in size and number according to the absorptive qualities of the soil until the maximum absorption of rainfall results. Should it be desired, spillways, under sluices or other devices may be set at intervals in each ridge to effect the flood irrigation of the land between the ridges. In addition surplus water may be stored in small open conservation works scooped out at the end of the ridges or situated at other convenient points. Contour furrowing of the areas between ridges will also prove of value in increasing absorption.

Certain areas are not capable of being contour ridged, and consequently the runoff after rain cannot be conserved on the areas themselves, and storm water from such areas will find its way into the natural drainage depressions such as streams and rivers. This surplus water is best dealt with by open conservation works situated in the stream and river courses; the works may be earthen dams where adequate and safe spillway facilities exist, or concrete, masonry or rockfill overflow dams. If such works are to be utilised for providing water for cattle throughout the dry season the depth of water stored must never be less than eight feet, but where the works are only for the purpose of storing water to improve flow conditions any lesser depth may be adopted. Silt traps are essential above

all small open conservation works in stream courses and these may be constructed economically by bolsters formed of boulders contained in heavy wire netting.

The reclamation of eroded areas is a necessary adjunct to any scheme of conservation, and although such works as small check dams are the most suitable, the expense of construction prevents their general adoption. However, a great deal of useful reclamation work may be carried out by the planting of suitable vegetation along the banks and in the beds of eroded gulleys; such plants as aloes, both exotic and indigenous, will be found useful and a study of the local vegetation will almost certainly result in other suitable plants being found.

Wind breaks on both arable and pasture land are very desirable to check the wind and so reduce soil evaporation losses, and these breaks may be formed by either leaving belts of natural trees at intervals, when clearing an area, or by the planting of suitable indigenous or exotic trees.

The foregoing remarks set out in general the main points considered necessary to any successful scheme of conservation in Matabeleland, but the successful initiation and carrying out of such a policy involves the all important matter of finance, both on the part of the Government and on the part of the landowner. In certain areas which may be described as "distressed," where the landowner is in an insufficiently sound financial condition to be able to spend money on essential conservation works, expenditure will have to be incurred by the Government with small, if any, expectations of a direct return on moneys so expended, and the indirect returns resultant on the reclamation, preservation and sound use of the natural resources to their maximum extent enabling the individual to perform his farming operations under reasonable conditions, may have to suffice.

It is, however, not desirable that work should be financed from public funds without any obligations being incurred on the part of the landowner, but if obligations are to be incurred they must be such as will not cripple his future activities.

The actual costs of construction, less the cost of Government European supervision, might be considered in the form of a mortgage, no interest being charged, but the debt falling due in the event of the property changing hands. This, however, has the disadvantage of affording practically no security where the property is already heavily encumbered unless mortgagees were prepared to waive their preferences, which is not likely to occur in the majority of cases. A further disadvantage of such a scheme is that it would be invidious to apply it to the distressed areas only and not permit it to be of universal adoption.

A better system to adopt appears to be one whereby a portion of the property is ceded to the Government in return for the construction of works on the remainder. In the majority of cases the sizes of holdings in the distressed areas appear to be in excess of what can be economically worked under the present conditions and a reduction in area with the provision of conservation works on the reduced area would greatly improve the

potentialities. It is suggested that the area to be ceded should be of such an extent, valued at the average market value of the land, as would represent the proportion of the cost of the works which should be borne by the individual. In the case of property already encumbered, it is considered that the security afforded by the smaller and greatly improved area would be at least as good as the original security.

Appendix VI.

MEMORANDUM DESCRIBING METHODS FOR SECURING BEST

GRAZING USE OF A TYPICAL GRANITE FARM.

The compilers of this report embody their opinions as to the most desirable and practical method of securing the greatest use from the grazing land of a typical Mashonaland farm of preponderantly granite formation and containing the usual proportion of vlei or swampy land.

It is considered that it should be taken as a general principle that the best use of grazing lands can only be obtained by methods of management which permit of a proper control of the veld herbage. The methods by which this can best be accomplished are bound to vary to a certain extent on different farms, as factors such as rainfall, the value of land, type of farming practised and the financial position of the farmer may all call for modification of any system recommended. In the following report, therefore, we have merely attempted to lay down certain general principles which it is realised will require modifications to suit special circumstances. The real aim in pasture management is to obtain the maximum production of herbage of the highest possible quality and its most effective utilisation on the farm. It has definitely been proved that, the more grasses mature, the less palatable, digestible and nutritious they become, though there is naturally a varietal difference in the degree to which different species deteriorate in feeding value. It is essential, in order to utilise the existing veld herbage to the best advantage, that effective methods shall be put into operation to control its growth and to conserve as far as practicable any surplus grass at a stage when its feeding value is of the highest possible value. Although never very nutritious as compared with cultivated pastures the average natural sandveld supplies fairly good grazing up to the time that the grass begins to flower, but if the growth is not controlled at this stage of maturity the grass usually rapidly decreases in feeding value. Where weather conditions permit of early haymaking, every effort should be made to mow early and secure hay of the best possible quality. We are definitely of the opinion that the mowing machine is one of the most important factors in connection with proper pasture management. It is realised that all the surplus grass on the farm cannot be cut for hay during the space of a few weeks, but such a procedure is unnecessary where a proper system of paddocking and controlled grazing is practised. Certain paddocks intended for hay, which for various reasons cannot be cut at the best season of the year, can be grazed for short periods in the early part of the growing season, thus checking the growth of the grass, and these paddocks can be cut later on in the year than the paddocks where the grass received no check in the early part of the season. The important point to be remembered in this connection is that it is the

stage of maturity of the grass, and not the month of the year, that is primarily responsible for the variations in its feeding value. The aftermath from paddocks cut for hay is of very much greater feeding value than the grass which is allowed to mature and ripen, and it is for this reason that every effort should be made to cut as much grass as possible on a farm during the growing season converting it either to hay or silage. Pasture control can be accomplished either by means of the grazing animal or by the use of the mowing machine or by burning. In the former case paddocking is essential, and the size of the paddocks should be limited so as to overcome as far as possible the tendency of animals to indulge in selective grazing to a destructive extent. Where land is cheap the bad effects of selective grazing can be limited by light stocking. In some cases this may be the most practicable and economical method of controlling the veld. Usually, however, a number of paddocks or camps will be necessary for proper grazing control. The actual acreage of the paddocks is immaterial so long as their area bears a proper relationship to the number of grazing animals. In the question of paddocking due consideration must also be given to economic factors, such as the utilisation of existing natural features, which will economise fencing, the best utilisation of natural water supplies, and other such factors.

In order to encourage the growth of grass and to permit of the use of the mowing machine, where and when necessary, the paddocks should at least be partially stumped in areas normally fairly heavily bushed. It must be remembered that the only alternative to the use of the grazing animal or the mowing machine effectively to remove roughage from areas in which the grass is allowed to get out of control is burning.

The burning of veld is likely to remain the most economical method of removing surplus vegetation for many years to come.

The effects of burning vary with the time of burning, the subsequent grazing treatment, the soil and the rainfall.

Veld burning to some degree is almost a universal practice on sour veld in Mashonaland and a critical study of the effect of burning is urgently necessary.

In the meanwhile it is suggested from general observation that from most aspects the most satisfactory time to burn is likely to be either before or after the first rains.

Attempts to improve the natural veld herbage by the use of artificial fertilisers are not to be recommended, as it has been proved that such procedure is definitely uneconomic. Fertilisers, however, can be used with considerable advantage on cultivated pastures. The laying down of temporary ley pastures, either as a rotation with other field crops, or solely for the purpose of supplying grazing and winter feed for the farm stock is strongly to be advised and is worthy of the attention of every farmer. A most satisfactory grass for this purpose is Rhodes grass, which has proved on many farms to persist for several years. With suitable fertiliser treatment, Rhodes grass will furnish at least four to five times as much hay to the acre as the ordinary veld grass, and such hay, in addition to being very palatable to stock, has a very much greater feeding value.

As the ordinary veld provides fairly good grazing during the first two or three months of the growing season, and, if properly controlled for an even longer period, the ley pastures should be reserved for hay purposes and the cattle put on to the aftermath late in the season. Such procedure considerably prolongs the grazing season and materially increases the carrying capacity of the farm. The dense cover afforded by cultivated pastures forms a very effective check to soil erosion, and reduces considerably the water runoff during periods of heavy rainfall. Further, the palatability and uniformity of cultivated pastures restricts the desire and possibility of animals practising selective grazing.

A SUGGESTED SYSTEM OF VELD MANAGEMENT FOR A SANDVELD

FARM IN MASHONALAND

It is therefore suggested that the following procedure should be adopted on sandveld farms.

The division of the farm into camps or paddocks should make provision for the following

- (a) Spring grazing.
- (b) Summer grazing and hay paddocks.
- (c) Winter grazing.

The spring grazing will normally consist of the poorest grazing on the farm, as even the "sourest" of grazing has some value at this time.

The winter grazing will normally consist of the vlei grazing and any aftermath on the hay or agricultural areas.

During the spring and early summer the cattle should be allowed as wide a range as possible, as heavy grazing at this period may cause considerable damage to the veld.

Later, as the grass tends to "get ahead of the cattle," the animals should

be concentrated in smaller paddocks where they can keep the natural growth of grass more or less in check. At this stage fairly heavy stocking does not apparently harm this type of veld.

The remainder of the summer area should then as far as practicable be mown for hay. When the hay has been cut the cattle can graze on the aftermath in addition to the grazing area just referred to. Surplus vegetation not consumed by the cattle or cut as hay should be burned when the accumulation of old material becomes excessive. Mowing should, however, be practised in preference to burning whenever practicable.

During the winter and spring months as much use as possible should be made of the vlei grazing.

Provision should be made so that any area summer or winter grazing showing overgrazing can be rested during the growing season. This rest may have to cover the early part of two growing seasons, i.e., the first one for seed to mature and the second to allow the seedling plants to mature. On this point further information is required. It would be wise in any case to rotate hay and grazing paddocks to allow them to overcome the possible adverse effect of continual cutting or grazing.

Supplementary feed, or improved vlei pastures, or good hay should be provided to carry the cattle over the period between the exhaustion of the vleis and the appearance of green grass on the burns. The amount will vary with the nature and length of the time these supplements should be fed, nature of the veld, the type and age of the cattle.

The four systems of management in the projected experiments of the Pasture Research Committee at Narandehlas which are planned to determine the weight of beef that can be produced per acre under grazing conditions and the effect of these systems on the natural vegetation are based, with appropriate modifications, on the general principles just outlined.

VLEI GRAZING.

The extent to which vleis can be utilised for grazing purposes depends to a large extent upon their degree of wetness. Very wet vleis provide little, if any, grazing, and in their existing condition may be dangerous to grazing stock, as the damp condition encourages internal parasites. Small areas of very wet vleis should, if possible, be fenced off to keep stock out of them, and where it is possible it is very desirable that this should be done to prevent the bogging of stock.

Semiwet vleis, if properly controlled, provide useful grazing although generally of rather low quality particularly during the early spring and winter

months, and, what is even more important, obviate the necessity of placing cattle too early on the ordinary veld, which is one of the factors responsible for the destruction of the veld by so-called overstocking. It is essential, however, that the grass on semiwet vleis should be kept short, as, if allowed to grow unchecked, the grass and sedges, owing to their fibrous nature, rapidly get coarse and rank and are unpalatable to grazing animals. Close grazing of such vleis, within certain limits, appear to encourage the growth of the better grass types and improves the quality of the grazing. Unless this procedure is adopted, burning provides the only alternative to secure proper use of the herbage.

Many semiwet granite vleis, if limed, ploughed and planted with suitable grasses such as paspalum, swamp couch, etc., will provide valuable grazing during the spring and winter months and will go far to solve the problem of winter feeding for stock.

The practice of utilising nonirrigated vlei lands for the purpose of growing wheat appears to us to be a questionable one as the average yield (one and a half bags per acre) is generally uneconomic and in many cases it would be more profitable to put the land down to improved pastures, provided the land is adequately protected by contour ridges and is suitably fenced, so as to ensure that the pasture is not overgrazed.

The tramping out of the veld by cattle round the watering places in vleis which are heavily grazed, and the constant use of the same footpaths should be controlled as they result in erosion and the formation of dongas.

Abandoned wheat lands erode rapidly and become a wasted asset. Such land should be protected and sown to grasses.

The establishment of improved vlei pastures will increase the humus and moisture contents of the soil and conserve the normal flow of water in the rivers, which is reduced by undesirable methods of cultivation of vlei land.

The ploughing up of natural veld or vleis is deprecated unless the area so ploughed up is properly protected by contour ridges and fencing and beneficial use is to be made of the land by the establishment of cultivated grasses or crops.

In cases where natural pastures are ploughed up and allowed to revert to grass, an immediate improvement in the palatability of the grass usually results. There is, however, to start with a considerable decrease in the bulk of herbage produced and, as stock tend to congregate on the ploughed area, on most farms local overgrazing usually causes a thinning of the grass cover which generally results in erosion.

A. E. ROMYN,

(Chief Animal Husbandry Officer).

A. I. HUSBAND,

(Chief Chemist).

D. E. MCLOUGHLIN,

(Agriculturist).